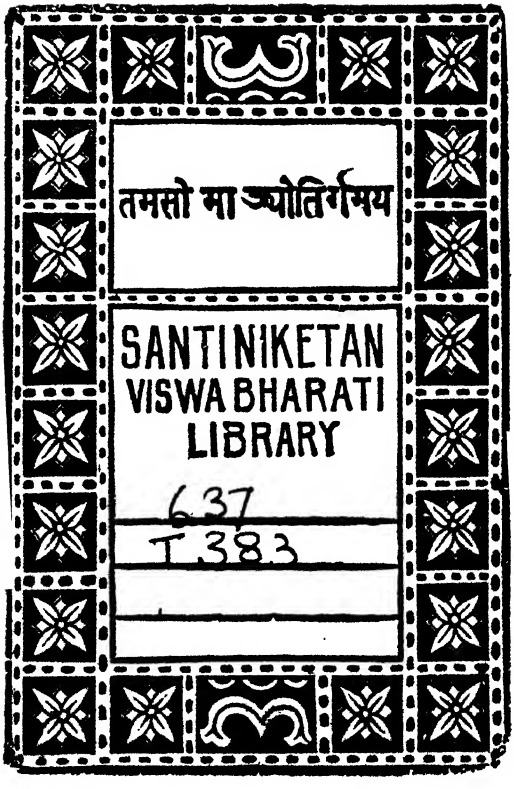
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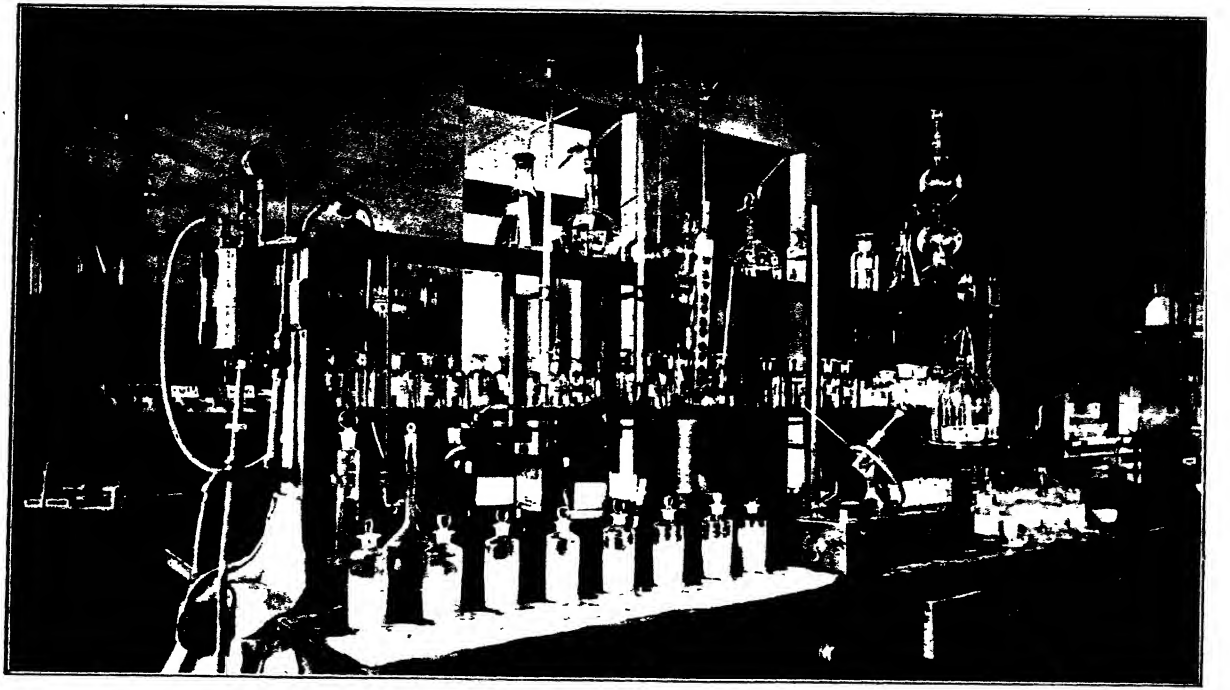
MILK AND CREAM TESTING



A Well-Appointed Dairy Laboratory.

MILK AND CREAM TESTING

AND

GRADING DAIRY PRODUCTS

For School, Farm, and Factory

BY

G. SUTHERLAND THOMSON

F.R.S. Ed.; B.D.F.A. Diploma, and N.D.D.

LATE GOVERNMENT DAIRY EXPERT FOR SOUTH AUSTRALIA AND QUEENSLAND,
AUTHOR OF "THE DAIRYING INDUSTRY," ETC.

WITH AN INTRODUCTION BY

SAMUEL LOWE

LONDON: CROSBY LOCKWOOD & SON

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INTRODUCTION

THE arts of making butter and cheese were followed in the earliest ages of which we have any record, and it is not unreasonable to assume that they were known to primitive and perhaps to prehistoric man. In what part of the world they were first acquired or among what race of people they were first practised is not known. The only indications we have regarding the time when they originated are the natural deductions that it was not before the era when primitive man began to domesticate the wild animals, and that it would be among a pastoral race, but whether among a nomadic or a stationary people is unknown. There are reasons for supposing that these handicrafts originated in the East, and that the first animals used for supplying man with milk were sheep or goats. The domestication of cattle would be much more difficult than that of sheep or goats, so that it is very probable the utilisation of the cow for milking did not take place until a much later period.

The art of buttermaking, like that of cheesemaking, requires great skill in manipulation and treatment of the raw material, as success depends upon the correct carrying out of the mysterious and difficult working of the laws of fermentation, and as the utensils of primitive

man were rude in construction it must have taken ages to bring the manufacture of butter and cheese to a practical business success. From the time when this result was achieved down to a comparatively few years ago, there was very little improvement made in the art of either the making of butter or cheese.

It was in the latter half of the nineteenth century before any noteworthy development took place, and then a discovery was made that completely revolutionised both processes. Strange to say, the discovery at first had no direct connection with either butter or cheese, but was confined to the brewing of beer and the making of wine. The vineyards in France nearly fifty years ago were attacked by a minute organism called *Phylloxera vastatrix*, and the vines destroyed. Scientists were called in to provide a remedy against this disease and this led to the study of the organism which caused the disease. It was owing to the investigation about the Phylloxera that Louis Pasteur began his researches into the causes of fermentation in wines and beers. It had been known to scientists for many years that in addition to the plants and animals visible to the ordinary human eyes, there existed another world of organisms so small as to be visible only by means of the microscope, but whether these microscopic forms played any part in the economy of nature, much less what that part was, had not been discovered. It was the genius of Pasteur in conducting his investigations that enabled him to make known that some of these organisms, viz.:—the yeasts, were the sole cause of the process of fermentation in wine and beer. Up to that time the general opinion

had been that fermentation was a chemico-mechanical change of inorganic matter.

The discovery that it was due solely to the microscopic organisms of the invisible world that mankind were able to carry on the great industrial operations of brewing and wine-making was a marvellous extension of human knowledge and an enormous widening of human thought.

Since Pasteur's labours, other investigators by means of improved microscopes and further study, have revealed to us that these microscopic existences fill the whole atmosphere for miles above the land and sea and not only clothe the surface of every inanimate object as well as of every leaf, plant and flower, but they even penetrate into the depths of the soil and the water.

The knowledge that the changes which take place in wine and beer were due to the existence of microscopic organisms named yeasts, naturally led to further inquiries as to the causes which brought about changes in other things, among which was the cause of milk turning sour.

Surprising as were Pasteur's discoveries about wine and beer, they are exceeded in interest by the researches of those who have investigated the causes of the changes that take place in milk and cream in the manufacture of butter and of cheese.

Pasteur discovered that the yeasts were really microscopic plants, each plant consisting of only a single cell, and so small that if 3,000 of them were placed in a row it would not measure more than an inch long. He also found that there were many varieties of yeast. Previous to this our knowledge of yeast was as indefinite as if

we had all our lives been unable to see the difference between wheat, barley, oats, maize, peas, and beans, but had called a mixture of them corn and had treated it as consisting of only one kind of seed. Pasteur's and others' later investigations showed that yeast is a mixture of different varieties of single cell plants each as distinct from the other as wheat is from peas and maize from barley. More recent researches prove that each variety of yeast gives its own particular flavour and bouquet to wine and to beer. Similarly another group of micro-organisms known as bacteria were brought to light which are found in the atmosphere everywhere. When these settle in milk they find the sugar of milk a suitable food and live and multiply on it. Each variety produces from the sugar a different acid, ether, aroma, &c., hence arise the different flavours and aromas of butter and cheese. As illustrating how these micro-organisms clothe everything, take the bloom of grapes. When this is examined under a powerful microscope it proves to be nothing more than wild yeasts, and each berry of the grape is found to contain on its surface about a dozen varieties of yeast as well as other forms of organisms such as moulds, &c. Experiment has established the fact that it is these wild yeasts on the grapes that give the flavour and bouquet to the wine made from them.

The microscope brought about the discovery that the invisible world contains many species and varieties of plants and forms of animal life, though not so many as those visible to the naked eye, but they are much more simple in structure and much more rapid in their

modes of reproduction. The life of each individual form is very short, consisting of only a few hours, but in that time it is capable of producing millions of successors. It is this enormous rapidity of multiplying that distinguishes them from the larger forms of life, and enables them to produce rapid changes both destructive and productive in the composition of liquids or semi-liquids. Like all other forms of life, temperature and moisture determine and control their activity. Most of them become dormant at low temperatures under dry conditions, but full of activity when in moist and warm temperatures.

Most changes that occur in wine, beer, and milk are, however, due to forms of micro-plant life, and only very occasionally to micro-animal forms.

Unless the above elementary knowledge is possessed by butter and cheese makers they cannot take an intelligent view of the operations of their art. It is possible for a man or woman to milk cows, to separate the cream from the milk, and to make butter and cheese without any knowledge of the elementary facts above mentioned, but then they are walking in darkness and comparative ignorance, and are constantly coming into contact with unexpected difficulties, which the information contained in this book would enable them always to avoid.

Science can be best defined as exact knowledge, and only by knowing exactly the properties and conditions of the materials he is using, can a man be said to be working scientifically or to be a scientific buttermaker or cheesemaker. If he knows the exact causes that

produce certain results, he can work intelligently and satisfactorily because he can always secure the results he requires.

It is a very rare occurrence that the author of a book dealing with bacterial life and the changes that arise therefrom, is a man who not only knows thoroughly the scientific theory of those changes, but who is through many years of actual work equally well acquainted with the practical operations of both buttermaking and cheese-making.

In this volume, "Milk and Cream Testing," the ideal conditions of theory and practice are combined in every chapter and in every line. This book is not the production of an idealist working in a laboratory, but is written by a man whose theory and practice have checked and controlled each other for many years, and the tests here given are the actual tests and methods of testing which years of experience have proved to be true and trustworthy.

Every detail of work connected with the dairy farm to the up-to-date butter and cheese factory is given its due place and proper consideration. There is nothing left out that is necessary for the working and managing of both the small dairy of a few cows and the factory that daily receives the milk and cream from thousands of cows. All the care and caution of what to avoid in the multifarious operations connected with the dairying industry so as to prevent the manufacture of inferior butter or cheese, are given with clearness and accuracy. Equally exhaustive and comprehensive are the many and varied details of what all buttermakers or cheese-

makers must do if they wish to conduct the business of dairying successfully, both from the financial side as well as that of producing the highest quality obtainable.

In those countries where the dairy industry is carried on as a manufacturing business on a large scale, this volume is invaluable to every individual employed in the industry. Every milk supplier, every manager of a skimming station, every manager of a butter or cheese factory, and every director of such business will find the study of this volume worth a thousand times its cost, and it should be a constant companion to each and all of them.

"Milk and Cream Testing" contains a great number of pictorial illustrations which make plain to an ordinary man the details of the most difficult points in the manipulation of the utensils used, and in the processes employed in the arts of butter-making and cheese-making.

Mr G. Sutherland Thomson has conferred an incalculable benefit upon the dairy industry throughout the world by the publication of this little book, and I greatly regret that my abilities are quite unequal to write an Introduction worthy of the volume.

SAMUEL LOWE,
W. Weddel & Co. Ltd.

LONDON, 12*th June* 1911.

PREFACE

MILK and cream testing is steadily increasing in importance, and it is a matter for congratulation that its advance is being more generally recognised as a primary part of the dairy farmer's education. In dealing with the subject and its allied parts, the writer has detailed the result of investigations, and given his experiences, extending over twelve years, in the Agricultural service of Australia, where milk and cream testing now occupies a high and permanent place in the education of the dairy student.

It is hoped that this publication will fill a want in the bookshelf of the dairy farmer, and help to show the great advantages of a system of testing as prescribed by the writer.

In some oversea countries where dairying is only developing, milk and cream testing will go far to harmonise the relationship between farmer and factory. It is necessary only to refer to the dissatisfaction that arises through fluctuations in the butter-fat values of farmers' milk and cream supplies, and the writer trusts that he has given sufficient evidence to show where mistakes may arise in the manipulation of milk and cream, and in the various processes of fat testing.

It should be unnecessary to point out that old and unsatisfactory practices of sampling these products should be discontinued, and it is the hope of the writer that this work, for which he claims originality, will be of assistance to the teacher and factory manager, and show to the farmer that approved methods in dairying protect him against abuses patent to the slipshod practices now disappearing. Let the mottoes "Practice with Science" and "Work and Learn," be strictly observed by everyone engaged to promote the interest of the Dairying Industry throughout the world.

The author suggests that this book should be studied in conjunction with "Dairying for all Countries," which will be published shortly.

G. SUTHERLAND THOMSON.

LONDON, *September* 1911.

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Milk and Cream Testing and Grading Dairy Products

CHAPTER I

THE MILK SUPPLY

Variations in the Percentages of Fat in Milk and Cream.

Before proceeding with the chapters in testing, it will be necessary for the reader to know where changes in the composition of milk and cream may occur, and with what consequences to testing. Further, as the fat ratio of milk and cream to butter should have a corresponding or relative value, it has been considered helpful to the student to go into the subject of the milk and cream supply more fully than is necessary in the ordinary practice of milk testing.

What is dealt with in this chapter is of considerable moment to dairymen and milk consumers. A close study of the question should be made by dairy farmers and Government and municipal officers, and a general

dissemination of information would lead to improvement in the milk supply. It also should be the effort of every dairyman to raise the standard of his herd of cows, and to thoroughly understand how to feed them to obtain the greatest practical benefit. He is likewise expected to be familiar with agencies which have an influence on the quality and yield of milk, not only before it leaves the farm, but in its transmission to the consumer. In the following pages the author has attempted to review the subject from a practical standpoint, with recommendations for the guidance of the industry. The chief causes of variations in the quantity and quality of milk are taken in the following order :—

THE COW.

BREED, TEMPERAMENT AND MILKING, TREATMENT, SEASON AND WATER SUPPLY, MATING PERIOD, HEALTH, PERIOD OF LACTATION, WEATHER, COW WITH CALF, INFLUENCE OF SHOWS, FEEDING.

BREED.—The quantity and quality of milk fluctuate in different breeds. Those of the Channel Islands excel all others in butter-fat, but the yield of milk is less than that given by the Holstein and Shorthorn breeds. The Holstein is recognised as holding the premier honours for yield, but the percentage of fat frequently falls below the 3 per cent. standard, without outside influences being the cause. Individuality of cows is another condition which must not be lost sight of, as

it is not unusual for cows of the same breed to show a marked difference in the total solids of the milk and the quantities given.

TEMPERAMENT AND MILKING.—The temperament of the cow is a great factor in milk production, and should be closely studied by every dairy farmer. With healthy digestion, good temper, and absence of nervousness, fluctuations in the quantity and quality of the milk would be less frequent. There is strong evidence that the nervous system of the cow exercises considerable influence on the solids of the milk and the yield. Take, for example, milking. When the hours are regular, the animals are taught to yield their milk at a certain time, and a continuation of this excites a sensibility in the cow to give her utmost, and to maintain both quantity and quality as long as other conditions remain favourable. Altering the hours of milking, or milking at irregular periods, is inimical to the activity of the mammary glands, or in other words to the temperament of cows, hence the teachings of expectancy are not brought into force with the same success as would follow if the hours were regular. Take as an illustration. Three cows under the supervision of the writer had the hours of milking changed from 5 A.M. and 5 P.M. to 6.30 A.M. and 3 P.M., with the following result :—

THREE DAYS BEFORE THE CHANGE

	Milking Hour, 5 A.M.		Evening, 5 P.M.	
	Net Milk.	Fat.	Net Milk.	Fat.
	Lb.	Per cent.	Lb.	Per cent.
Cow 1 -	13.0	3.7	11.5	3.8
Cow 2 -	12.0	3.6	10.0	3.8
Cow 3 -	11.5	3.7	11.0	3.6
Cow 4 -	16.0	3.5	15.0	3.6

THREE DAYS AFTER THE CHANGE.

	Milking Hour, 6.30 A.M.		Afternoon, 3 P.M.	
	Net Milk.	Fat.	Net Milk.	Fat.
	Lb	Per cent.	Lb.	Per cent.
No. 1 -	14.0	3.3	9.0	4.0
No. 2 -	14.5	3.0	7.0	4.1
No. 3 -	12.5	3.4	9.5	3.7
No. 4 -	17.5	3.3	14.0	3.4

In extensive experiments on the feeding of dairy stock conducted by the writer some years ago, cows were milked at the following hours:—

Lot 1. 3.45 A.M. and 3.45 P.M.
„ 2. 7 A.M. and 5 P.M.
„ 3. 5.30 A.M. and 12.30 P.M.

Selecting one cow from each lot, two of which were

advanced in calf, their average yield of milk and fat percentage were as follows:—

	Quantity of Milk.		Proportion of Fat.	
	Morning.	Afternoon.	Morning.	Afternoon.
	Lb.	Lb.	Per cent.	Per cent.
No. 1 -	16.0	16	5.2	5.2
No. 2 -	5.5	5	3.9	4.6
No. 3 -	8.5	6	3.9	5.0

First Milk v. Strippings.—It is well known that the first drawn milk from cows is very poor in fat; the middle milk contains a higher percentage, while the strippings are very rich. 1.8 might be taken as an average percentage of fat for the first milk, 4.3 for the middle, and 7.5 per cent. for the strippings. In individual animals the percentages would certainly vary.

TREATMENT.—Rough treatment of cows either immediately before or during the operation of milking, when the activity of the mammary glands is most desired, has a disastrous effect on the yield of milk. So injurious are these common errors in dairying that in some instances the results would seem incredible, as the following illustrates: As customary, two cows were milked at 5 A.M. and 5 P.M.; the following morning both were milked at the same hours, but, contrary to rules, the animals were hunted into their milking sheds, and otherwise roughly handled. The effect of

the evil practice will be shown in the accompanying figures :—

	Before Rough Usage.		After Rough Usage.	
	Quantity of Milk.		Quantity of Milk.	
	Morning.	Afternoon.	Morning.	Afternoon.
	Lb.	Lb.	Lb.	Lb.
No. 1 -	12½	11½	6	10
No. 2 -	9	9	5	8
	Per cent. Fat.		Per cent. Fat.	
No. 1 -	3·9	4·0	3·2	3·7
No. 2 -	4·1	4·2	3·1	3·8

SEASON AND WATER SUPPLY.—The season of the year exerts an influence on the milking properties of cows, and in warm weather, and when the food is dry, the variations in the fat percentages and yield of milk are greater. In the hot parts of the day cows will not exert themselves to obtain water unless the supply is conveniently situated. Cows usually drink in the cool of the morning or evening, and the quantities consumed will vary according to the extent of the heat, and the nature and amount of food eaten. It is, therefore, reasonable to expect that poor herbage, having a tendency to weaken the digestive organs of the cow, will decrease the total solids in the milk, and the injury will be greater when the proportion of digestible matter is small.

It is well known to dairymen that thunderstorms have a reducing effect on the milk yield of the cow. During these disturbances the mammary glands appear to lose their activity. There are many other outside influences which have a similar action on the formation of milk in the udder of the cow.

MATING PERIOD.—When cows show a desire to mate, the excitability is so great that the milk flow is seriously interrupted. Especially is this noticeable in warm weather, and the flavour of the milk may also suffer as well as the yield and total solids.

HEALTH.—Freedom from disease is another matter which should not be overlooked when shrinkage in the milk flow and a loss in total solids are under consideration. Bodily ailments, chief among which are mammary disorders, exercise an influence upon the milk yield.

LACTATION.—The period of lactation likewise changes the composition of cows' milk, and if other conditions are affecting the production at this period, the milk would be considerably reduced.

WEATHER.—The temperature of the atmosphere exerts a change in the yield and quality of a cow's milk, and in some instances the shrinkage is very marked. The author has known of a herd to fall off in the butter returns by 2 lb. per animal per week due to the weather, and to regain their normal state of milking upon the return of favourable temperatures. It may further be pointed out that exposure to excessive heat is likewise hurtful to cows; and, although it may not be credited by some people that the milk supply may suffer

heavily, the reducing influences of heat are known to practical dairymen. Where milking stock are exposed to the full effects of the weather strong efforts should be made to provide shelter belts of trees. This applies to all countries, and proves a very profitable protection.

COW WITH CALF.—Permitting the calf to run with the mother is another source of danger to the cow's milking qualities. An instance came before the notice of the writer where a cow in full milk was suckling two calves, and through the death of the animals she did not yield more than a half gallon per day by hand-milking. Cases of a somewhat similar kind are not uncommon where the custom of allowing the calf to run with the mother is followed.

INFLUENCE OF SHOWS.—It is a well-established fact that cows tested at shows do not yield so much milk, and of the same quality, as when milked at home. The strange surroundings and the excitement of the show-yard are, no doubt, responsible factors in causing the shrinkage. It is safe to infer that exhibition trials are not a true test of the milking qualities of cows. Careful fat analysis taken at an agricultural exhibition showed low and irregular reading, and from what the writer knew of the milking attainments of the cows, the fat should not in any instance have fallen below the 3 per cent. standard. The following is an abstract from the official report of the judges:—

	First Morning.		First Evening.		Second Morning.		Second Evening.	
	Milk.	Fat.	Milk.	Fat.	Milk.	Fat.	Milk.	Fat.
	Lb.	P. cent.	Lb.	P. cent.	Lb.	P. cent.	Lb.	P. cent.
Minnie	25.6	2.2	23.7	4.0	28.4	2.6	23.0	4.2
Daisy -	27.7	2.8	21.12	5.5	23.6	3.0	22.6	3.7
Plum -	27.10	2.8	23.2	4.2	30.10	3.3	14.13	6.4
Bess -	17.12	3.6	15.2	5.2	18.1	2.8	16.0	4.8

The hours of milking were 7 A.M. and 5.30 P.M.

FEEDING.

The question of feeding milking stock more liberally during the precarious months of the year is of vital importance to the Colonial and foreign dairy farmer, and should no longer be neglected. To demonstrate the value of attention to this subject, extensive experiments were conducted by the writer in South Australia during the year 1901.

Work in this particular line was urgently required, as dairymen held adverse opinions relative to the milk-producing properties of the commonest foods sold, and ridiculed the practice of hand-feeding on the basis of the cost incurred, and the slow and unstable influence which foods were believed to exert upon the milk flow and its butter-fat percentages. Hand-feeding in the dry months, when nutritious fodder is scarce in the fields, is imperative. With dry and unnutritious herbage as the only support, milking cows suffer in constitution, and, if this condition is permitted to continue, emaciation

of the body follows as a natural consequence. Animals with marked milking attainments will become seriously injured, as more digestive food will be converted into milk at the cost of the cow's vitality. Further, the constitutions of the strongest cows weaken, functional derangement and disease of the organs follow, and many animals succumb to ailments brought on by no other cause than sheer starvation. And this does not end the danger arising from scanty feeding, for the unborn calf is deprived of the support which should be given by a healthy mother to lay the foundation of a good constitution in her offspring.

The greatest response to systematic and judicious feeding is evidenced amongst animals less fortunate than the well-cared-for cow, and where the inherited strong milking qualities have not been thoroughly attended to. It has been shown in the author's experiments that a well-balanced and succulent food will raise the quantity and quality of a cow's milk if the previous course of feeding has lacked in the required constituents and moisture; but it is a belief that has unfortunately become established amongst many dairymen that feeding will reduce the weight of milk when it influences the fat percentage and the total solids to a high standard. Hand-feeding, when done in conjunction with careful milking, and close attention to other matters of importance, will increase both the quantity and quality of milk from the average cow, and this can be maintained by changing the rations from time to time. Some people might call such a system forced feeding, causing damage to the health and future

milking capabilities of the animal; but it is not the case so long as the food is wholesome and free from injurious properties, and not given in excessive and irregular quantities. Feeding the already well-nourished cow, however, with food rich in albuminoid matter will not as a rule raise the standard of her milk. She has already reached her maximum, and what is not required for milk will, according to her fattening propensity, be converted into flesh or excreted from the body. It is here that the old maxim "Feed for quantity and breed for quality" cannot be exploded.

Experiments to Ascertain Fat Variations in Milk.

In order to demonstrate by actual practice the extent of variations that occur in the composition of milk, the writer conducted fourteen days' tests of the milk from one cow. The milk was analysed for butter-fat morning and evening of the first, middle, and last week.

The Test.

The test cow was taken from amongst a herd grazing in a field where a good supply of herbage was at her command, but no hand-feeding was practised.

For convenience of testing, the cow was put into a yard, and her food for the first four days consisted of chaffed hay, while bran was included in the rations to follow. Abundance of water was supplied to her daily, and to all appearance the cow took kindly to the change, no difficulty being found in the operation of milking, and no shrinkage in her usual supply. With these

favourable conditions, testing began in the morning of the third day from the date of the cow's enclosure, and continued without intermission until the expiry of the first fortnight, when the animal was removed to her old quarters for a few days, and thence taken back to conclude the remaining fourteen days. The results obtained during the last fourteen days corresponded with the first half of the experiment, so that the tables of tests to follow may be safely relied upon.

The hours of milking were at 7.30 in the morning and 5.30 in the evening.

The following gives the creamometer readings and the fat yields during the hay-feeding, omitting the first two days :—

CHAFFED HAY FEEDING.

Date of Test.	Creamometer Readings.			Fat Tests.		
	First Milk.	Middle Milk.	Strippings Milk.	First Milk.	Middle Milk.	Strippings Milk.
	P. cent.	Per cent.	P. cent.	Per cent.	Per cent.	Per cent.
March 18	2.0	7	10	1.3	2.6	4.4 Morn.
	3.0	8	12	2 8	5.0	6.8 Even.
„ 19	2.0	7	11	1.4	3.5	8.2 Morn.
	3.0	9	13	2.6	5.1	6.4 Even.
„ 20	2.0	7	12	1.6	3.8	6.3 Morn.
	3.0	8	13	2.7	4.6	6.3 Even.
„ 21	1.5	11	15	1.2	3.9	7.8 Morn.
	3.0	10	13	2.8	5.0	6.3 Even.

Observe the high percentages of fat in the first and middle drawn milk of the evening, and the low per-

centages of fat in the strippings. The strippings in the creamometer tests are somewhat opposed to the butter-fat reading, but this can be accounted for by the increased percentage of cream becoming checked in its ascent to the surface by the viscosity of the milk.

CHAFFED HAY AND BEAN FEEDING.

Date of Test.	Creamometer Readings.			Fat Readings.		
	First Milk.	Middle Milk.	Strippings.	First Milk.	Middle Milk.	Strippings.
	P. cent	Per cent.	P. cent.	Per cent.	Per cent.	Per cent.
March 22	2.0	9	14	1.5	3.8	7.8 Morn.
	3.0	11	16	2.7	5.2	6.0 Even.
March 23	2.0	10	14	1.0	4.8	10.2 Morn.
	2.0	11	16	2.5	4.6	8.0 Even.
March 24	2.0	11	16	1.6	3.7	7.6 Morn.
	2.0	10	15	2.7	4.3	6.1 Even.
March 25	1.0	11	16	1.0	3.4	10.0 Morn.
	2.0	12	17	2.6	5.0	8.2 Even.
March 26	2.0	11	18	1.3	4.0	10.0 Morn.
	3.0	13	16	2.8	5.2	7.3 Even.
March 27	2.0	12	15	1.4	4.8	7 8 Morn.
	3.0	12	16	2.7	4.8	7.3 Even.
March 28	2.0	10	17	1.2	4.5	9.2 Morn.
	3.0	12	16	2.1	4.8	8.0 Even.
March 29	1.5	12	18	1.7	4.4	9.2 Morn.
	3.0	12	17	2.0	6.0	8.0 Even.
March 30	2.0	12	16	1.8	4.0	9.1 Morn.
	2.5	11	17	2.2	4.8	7.9 Even.
March 31	1.0	10	19	1.0	4.0	10.0 Morn.
	2.0	11	16	2.2	4.8	7.8 Even.

The addition of bran resulted in an increase in milk of fully one quart per day.

FOOD AND MILK.—In comparing the effects of the two feeds on the quality of the milk, it is clearly illustrated that a marked improvement has followed the change in the rations. Throughout the experiment the first-drawn milk has not altered to an appreciable extent, the middle milk is practically the same; but in the case of the strippings there is a marked contrast, the latter feeding giving a much higher quality than the hay alone. In glancing over the figures, readers might take note of the greater regularity of the readings which have followed the pursuance of the experiment.

AN IMPORTANT FEATURE OF THE TEST.—The most important feature of the fat experiment is the singularity of the first and middle milks of the evening being higher in fat percentage than the corresponding morning milk, while the strippings are the reverse. This peculiarity has been confirmed by other tests. The percentage of fat in the bulk samples, however, favoured the evening's supply, which can be attributed to the strippings, which comprise such a small quantity of the yield, and the first and middle milk show a better quality against the morning supply. This was exemplified in tests made with 4 oz. samples of first, middle, and last quantities of milk from a control cow which was kept under observation for sixteen days. The average percentage of fat in the morning was 4.1, and the evening showed 4.3, while the morning strippings gave an average of 6.2 against 5.8 in the evening.

With a view to determine the variation in the milk solids, and to justify the fat tests, analyses were made of one day's first and middle milk and strippings of both

the morning and evening's milking. One of the test cows in No. 1 feeding experiment was selected, and the analyses illustrate how close the morning and evening percentages were, but the fat readings favour the peculiarities already referred to:—

ANALYSES OF EVENING'S MILK.

	Water.	Fat.	Total Solids.	Solids not Fat.	Specific Gravity.
First Milk -	86.35	2.2	13.64	11.44	10.37
Middle Milk -	83.36	5.5	16.63	11.13	10.33
Strippings -	79.76	9.6	20.23	10.63	10.27
ANALYSES OF MORNING'S MILK.					
First Milk -	87.63	2.0	12.37	10.37	10.36
Middle Milk -	83.31	5.3	16.69	11.39	10.31
Strippings -	79.75	8.4	20.25	11.85	10.27

The Milk Standard.

The law in force in English-speaking and other countries to prevent adulteration of milk, is unquestionably unjust, and wholly unprotective to the consumer. In Australia, and the same applies to Britain, a conviction may be obtained against any person who offers milk for sale, which upon analysis is found to be below the legal standard, and it matters not what circumstances may be in favour of the seller, practically nothing is taken into consideration on his behalf. The milk supply of most cities is drawn from the country, and to my knowledge

there are few precautions taken to prevent interference with the milk before delivery to the town seller. During the transit of the milk, great changes undergo in its composition, through jolting, and the influence of temperature. But the law does not recognise this,

During a fourteen days' milking test of a Jersey-Shorthorn cow, conducted by the Queensland Department of Agriculture, the milk yielded 41.43 lb. of butter-fat, equivalent to 24·35 lb. of commercial butter, per week. Notwithstanding the above magnificent result the writer had on several occasions found the milk of this cow to fall below the 3 per cent. standard. This occurred when the animal was under a series of milk tests, and was caused by nervousness.

neither does the inspector exercise any particular care in the method of taking samples for analysis, everything being done to justify a conviction. Is it not absurd to punish a milk vender because the dairy farmer, or the wholesale buyer is guilty of adultera-

tion? To fine an English grocer for selling butter that has been adulterated in Australia or some other country, and who bought it as a pure article, is unfair, to say the least of it; still it is the law, and must be obeyed. Charges of dishonest trading should certainly be brought home to the guilty, and they should be dealt with in a severe manner, as the lives of delicate people and children are largely dependent upon the nutritive and health-giving properties of a pure milk supply. But upon all things let the law be just.

Registration of Dairymen and Milk Venders.

Dairymen and milk venders should be licensed, which is the law in Queensland, and it should be so arranged to enable authorities to refuse, cancel, or withdraw any licence as occasion may demand. Under such a system there should necessarily be efficient inspection to guarantee a clean and bacteriologically pure milk supply; but the serious question of water adulteration and added preservatives would require to be grappled with, and which could not be done without enforcing other protective measures.

State-Controlled Milk Depots.

Were depots established by the State, milk could be purchased from the dairy farm on the butter-fat test, which alone is a very valuable factor in support of such an institution, and further it would close the principal channels through which adulteration finds a safe and profitable course. Combined with this valu-

able protection to consumers, State depots would be far reaching in their application to the breeding, feeding, and management of dairy stock; just as the system of purchasing milk by butter and cheese factories has encouraged friendly rivalry amongst farmers to improve the milking properties of their cows. Working in conjunction with these suggested depots, would be the licensed retailers, who would deliver milk of a known strength to the consumer. (See work entitled "Dairying for all Countries.")

Errors in Sampling Milk.

INFLUENCE OF TEMPERATURE ON THE FAT PERCENTAGE AND DENSITY OF MILK.—Temperatures act quickly on milk and cream, not only in causing deterioration, but in bringing about an uneven distribution of the fats and non-fatty solids. Here will be found illustrations depicting the changes the latter product undergoes when left undisturbed at ordinary temperatures, but where artificial cold is brought to bear on cream or milk, the separation of the fat from the non-fatty solids is of striking evidence. To prove the influence of temperatures in this direction, the following test was conducted in Queensland by the author in the summer of 1906:—

At a vender's premises, where milk was received from the country, and stored in a refrigerated chamber, the writer, in company with a Government dairy inspector, awaited the arrival of the milk, and obtained samples from each farmer's supply, using a syringe in taking same from the top, middle, and bottom of each

can. Immediately this was done, the milk was removed to cool storage and kept there until required for sale, when each supply was again sampled in the same manner. The results of the fat tests and analyses for total solids and water are as follows:—

	Fat per cent.			Gallons.	Temperature, Fahr.
	Top.	Middle.	Bottom.		
A - -	4.3	4.4	4.1	2½	72°
B - -	4.8	4.8	4.5	5	70°
C - -	3.8	3.8	3.6	6	84°
D - -	5.0	4.6	4.6	8	76°
E - -	4.2	4.1	4.0	7	80°
F - -	3.9	3.8	3.6	6	70°
G - -	4.3	4.2	3.9	10	82°
H - -	4.9	4.8	4.8	8	74°
I - -	4.0	3.8	3.8	4½	85°
AFTER CHILLING, SAMPLES TAKEN 3.30 A.M. FOLLOWING DAY.					
B - -	14.0	2.2	1.4	5	35°
C - -	18.0	1.0	0.5	6	35°
D - -	12.0	2.4	0.9	8	35°
E - -	13.0	1.2	0.4	7	35°
F - -	21.0	2.2	0.8	6	35°
G - -	19.5	0.8	0.6	10	35°
H - -	18.0	2.3	1.0	8	35°

A and I were accidentally removed from chamber before the second examination.

Evening's Milk before Chilling.

Samples taken at 8 P.M. *on 7th June.*

	Fat per cent.			Gallons.	Temperature, Fahr.
	Top.	Middle.	Bottom.		
1 - -	4.6	4.5	4.7	8	86°
2 - -	4.3	4.3	3.6	10	79°
3 - -	4.5	4.6	4.5	5	78°
4 - -	3.8	4.0	4.0	4	82°

Evening's Milk after Chilling.

Samples taken 12.30 P.M. *8th June.*

	Fat per cent.			Gallons.	Temperature, Fahr.
	Top.	Middle.	Bottom.		
1 - -	10.2	2.6	2.6	8	86°
2 - -	24 0	1.9	0.5	10	79°
3 - -	19.5	1.2	0.8	5	78°
4 - -	7.0	1.2	0.9	4	82°

CHEMICAL ANALYSES.

TOTAL SOLIDS AND WATER IN MILKS.

Before Chilling.

	Total Solids.	Water.	Total Solids.	Water.	Total Solids.	Water.
B - -	13.92	86.08	13.89	86.11	13.64	86.34
C - -	12.78	87.22	12.81	87.18	13.85	86.15
D - -	14.21	85.79	13.98	86.02	12.94	87.06
E - -	12.83	87.06	10.91	89.09	12.32	87.68
F - -	12.66	87.34	12.60	87.40	12.35	87.65
G - -	13.05	86.95	14.45	85.55	12.81	87.19
H - -	12.68	87.22	12.75	87.25	12.68	87.32

After Chilling.

	Total Solids.	Water.	Total Solids.	Water	Total Solids.	Water.
B - -	20.04	79.86	11.45	88.55	10.88	88.14
C - -	24.44	79.96	10.10	89.90	9.63	90.37
D - -	19.76	80.24	11.05	88.95	10.09	89.91
E - -	20.42	79.76	10.15	89.85	9.41	90.59
F - -	26.59	73.41	11.05	88.95	9.97	90.03
G - -	26.10	73.90	9.60	0.40	9.67	90.33
H - -	24.46	75.54	11.10	88.90	10.01	89.99

From these results it will be noted how easily an error may arise by neglecting to thoroughly mix the milk previous to distribution. In such a case the dairyman would be subject to severe punishment for adulteration. That marked changes in the fat and non-fatty solids of mixed milks take place is not difficult

to explain. When refrigerated and non-refrigerated milk are mixed and quickly retailed on the dairyman's round, efficient blending to prevent an even distribution of the solid matter does not take place. Layers are formed through the speedy separation of the milks of different temperatures, thus accounting for the variations alluded to.

Sampling from the Cart.

To illustrate the variations in the quality of milk on the retailer's rounds of delivery to his customers, the following instructions were issued by the writer in his official capacity to an inspector to accompany a dairyman in the disposal of his supply and to obtain samples of milk for analysis :—

a. By the use of a syringe draw a sample of milk from the bottom to the top of the can immediately the milk is received into can.
b. From top of full can.
c. From bottom to top when can is half empty.
d. Take sample from tap when can is half empty.
e. From tap when can contains one quart.

The samples were the same in quantity, and each was tested in duplicate for butter-fat.

The tests were as follows :—

a. From bottom to top of full can	2.2
b. From top of full can	2.2
c. From bottom to top of half empty can	3.4
d. From tap of half empty can	2.6
e. From tap when can contained one quart	3.4

A second test was made in a similar way, but two cans were examined in place of one. The results were :—

From bottom to top of full can - -	3.2	and	3.8
From top of full can - - - -	2.4	„	3.0
From bottom to top of half empty can	3.8	„	3.8
From tap of half empty can - -	3.8	„	3.8
From tap when can contained one quart	4.0	„	4.0

From further tests the writer had similar results, some falling considerably below the 3 per cent. fat limit, while other tests made from the same milk in the supplier's can showed a marked increase in fat. In the summer months when milk contains an excess of lactic acid, or in other words, is "off," churning takes place, and particles of butter adhere to the sides of the can and float on the surface. In this case the milk would be poorer at the bottom of the can. It is therefore necessary for city suppliers to exercise extreme care in thoroughly mixing refrigerated and unchilled milk; also quantities in which the fat content and acidity varies. In winter weather the danger is not so marked, and the last of the milk in the can will be more likely to contain the cream than show a poor quality, as illustrated by the tests.

Acidity of Milk and the Churning of Fat.

When milk develops lactic acid it is more liable to churn in the cans, and the danger is increased by the vibration and jolting caused in its transit by road and rail. In the summer weather churning of the fat is of

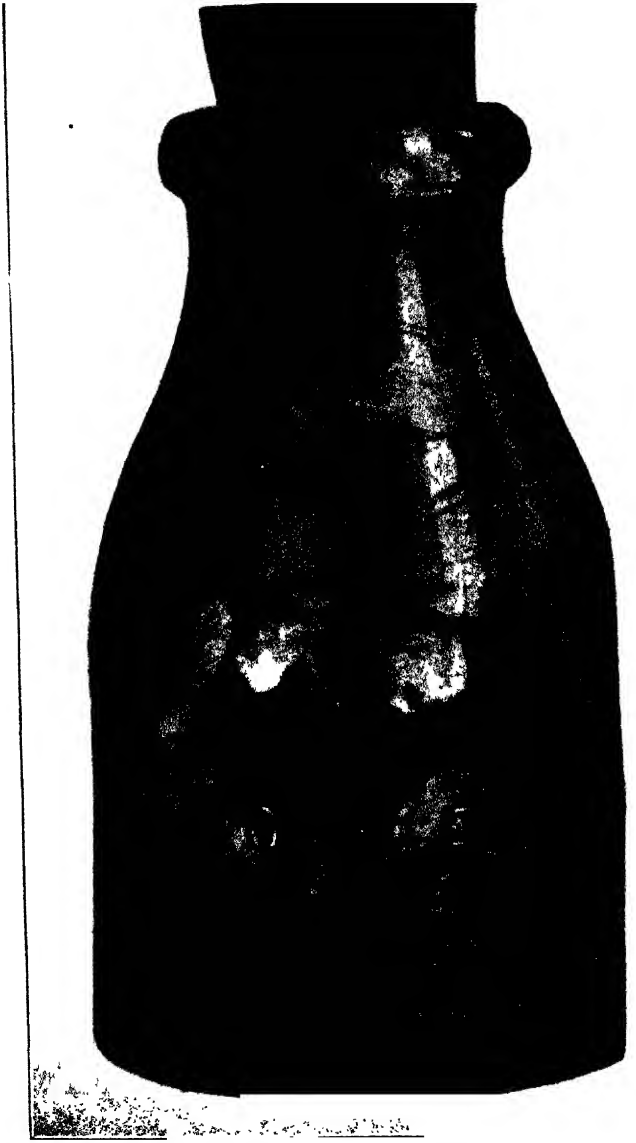
common occurrence, the temperature of the atmosphere being highly favourable to the production of the acid. To show how this condition will affect the fat standard, the writer made a test as follows :—

A can of sweet milk of 3.8 per cent. fat was taken round in the usual way in a milkman's cart, and at intervals of four minutes small quantities were run off and put into another can. This was continued until only one quart remained in the vessel. The temperature of the milk had risen from 68° to 79° Fahr., and there was a slight flavour of acid, the weather being warm at the time. On the sides of the can particles of butter were noticeable, also clots of cream, and on the surface of the milk a similar condition was observed.

A fat test was made of the milk from the tap and it barely went 3 per cent. Had the milk remained longer in the can it would certainly have given up more of its fat to be changed into grains of butter and clots of cream.

Milk is also subject to a peculiar form of coagulation, which exercises considerable influence on the solid matter, making its distribution very uneven. Cases of this kind have come before the writer's notice several times, and on each occasion there was no evidence to show that the coagulation was assisted in any way by the lactic acid. Fat tests made of this milk gave in some cases widely different readings, which further shows the gravity of taking samples for analytical purposes.

In the publication of the writer's last treatise on "Variation in Milk, &c.," the necessity for exercising



ILLUSTRATING THE ACTION WHICH TAKES PLACE IN COAGULATED MILK.

more than usual precautions in the mixing of milk and cream before taking the sample was shown, and to reduce the possibilities of error, a plunger designed by the writer was recommended and which is now being profitably used in Australia. To verify what has been said here, and to justify the need for introducing such an instrument, further experiments were conducted, and the conclusions were supported by investigations made in other countries.

Milk Tests for Householders.

The importance of the milk supply to the householders calls for the introduction of practical tests to assist in the detection of an inferior product. How can this be done? The first step is to apply the sense of taste. If milk is pure and sweet, it will have a sweet pleasant flavour, something that impresses one that richness is there, that it is fatty and nourishing.

On the other hand, if the quality has been reduced by the addition of water, the natural sweetness disappears in proportion to the added water, the colour is not so bright, a bluish tint taking its place; there is something insipid in the flavour, something cold, as the absence of the fatty solids takes away from the milk that softness peculiar to a pure product.

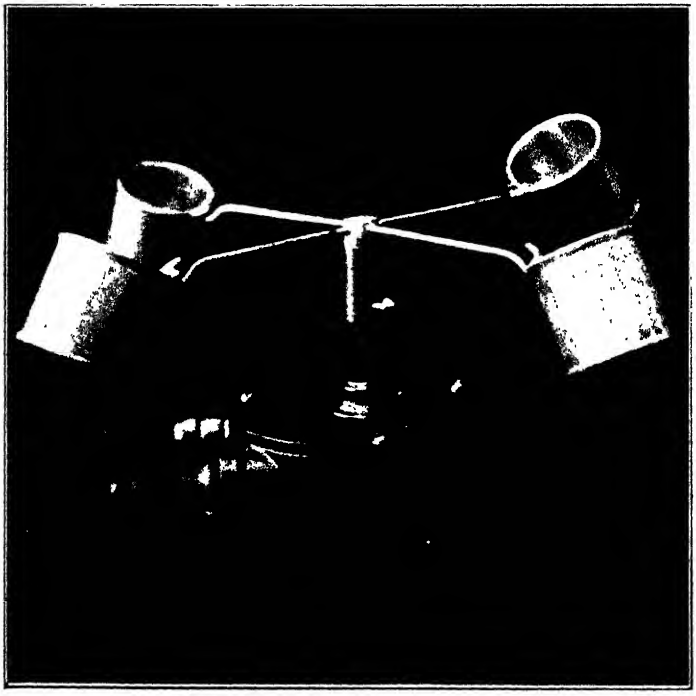
The consumer can advance a little further and use an instrument called a lactometer, which gives the density or specific gravity of the milk. It is known that poor milk weighs more than rich milk; it contains a higher proportion of heavier solids and less of the lighter constituents, fat.

But the lactometer is not infallible as a test, for milk may be reduced in quality and another substance added to make it of the same density as it was in the beginning. To guard against this, a creamometer should be used in conjunction with the former instrument. To manipulate the test, the following directions are given. Mix the sample thoroughly; fill the creamometer a little above the top line in the graduations; put the lactometer in the milk and note the degree at which it floats, 1.028 to 1.032 being taken to represent a good quality. After taking the reading remove the instrument and immerse the creamometer into cold water; at the end of ten hours read off the percentage of cream. The creamometer, however, will not give satisfactory results if the milk sours before the cream has risen, and in the summer months this condition should be prevented.

TEST 2.—The addition of water to milk reduces its adhering properties. This can be detected when milk is shaken in a glass, the thinness of the product causing a separation into rings which expand in proportion to the adulteration. After a little practice the average milk consumer will be in a position to recognise an inferior milk from a fatty product by the application of this simple test.

TEST 3.—Where large quantities of milk are consumed the water motor testing apparatus should find a permanent place amongst the domestic appliances; and it should not be confined to large establishments, but the householder would find the tester invaluable in recording the fat percentage of his purchases. The instrument herewith is so designed to be

driven by a simple pressure of water from the tap, and the improvement made in the glassware and system of testing, brings its application within the scope of every intelligent person. In addition to testing, the motor is designed to clean the bottles by means of revolving brushes. This is an acquisition not hitherto offered in testing appliances. (*See* MILK TESTING.)



SIMPLE WATER MOTOR FOR MILK AND CREAM TESTING.

Pasteurisation—Abuses of the System.

Notwithstanding the great and valuable advantages which pasteurisation gives to milk consumers, the

necessity for strict cleanliness in all that pertains to the dairy should not be lost sight of. We find that the virtues of heated milk have been made widespread by writers and lecturers, and a feeling of comfort exists amongst the people, which has to some extent reacted on the influences that were operating towards a purer milk supply. In other words, pasteurisation and sterilisation of milk are terms so acceptable as to be used as a cloak to hide insanitary practices, and this will continue in all countries, until inspection of dairies becomes compulsory by Act of Parliament.

From what experience the writer has had, illness through contamination of milk may also be attributed to causes other than the dairy, namely, carelessness by the consumer in exposing milk to an impure atmosphere and by keeping the product in inferior and badly cleaned vessels. More stress should be given to this part of the subject by health authorities.

The Separator.

We now come to an important cause of variation in the percentage of fat in cream, and which will be dealt with in a general way.

To separate in a satisfactory manner, attention must be devoted to the physical condition of the milk and to important requirements of the machine. So momentous are these, that a full explanation of each is necessary; but before discussing them it will be necessary to enumerate the chief points in separation

worthy of the dairy farmer's most serious consideration :—

a. Solidity of foundation and working efficiency of separator.
b. Physical condition of milk.
c. Speed of separator and inflow of milk.
d. Practice of separation.
e. The uses of water and skim milk before and at conclusion of separation.
f. Alteration of cream screw.
g. Thickness of cream skimmed.
h. Warming bowl before separation.
i. Cleaning the separator.
j. Adding colostrum or new milk to the supply.
k. Addition of preservatives to milk.

Notice A directs attention to a weakness that is not of uncommon occurrence, and where it exists uniformity in skimming will not be attained. Further, we find that parts of the separator are out of gear, and under such a condition, with work of so delicate a nature, variations in the cream returns must necessarily result.

Notice B.—It is universally recommended to separate immediately after milking, and why this should be so persistently advocated is for the following reasons :—

a. The milk has a very fluid condition.
b. It is free from acidity.
c. It is not dense.
d. The fat globules are not dangerously grouped.

e. The adhering power of casein and other substances to fat globules is decreased.

In cold milk we have conditions opposite to the above, which at once explains the inability of the separator to accomplish clean skimming. We also observe that when cold and warm milk are mixed together there is a loss in cream; but this practice is met with more frequently in the colder temperatures of winter. In the summer time, when milk is kept overnight and separated on the following morning, there is a loss of fat in the cream owing to a degree of acidity or sourness having developed, causing an increase in the density and viscosity of the milk. For this reason it is preferable to separate "old" milk by itself at a time and season when the weather is unfavourable to a high degree of fermentation. We also suffer losses in our cream returns when milk is carted long distances before being passed through the separator, and jolting in carts and exposure of milk cans to high temperatures cause a condition in the milk that taxes the efficiency of separation to its utmost, and may result in the escape of a considerable percentage of cream and butter-fat in the separator milk.

Notice C.—The speed of the bowl should not be less than the number of revolutions recommended by the manufacturers, otherwise a falling off in the power will reduce the skimming qualities of the separator. The inflow of milk must not exceed the quantity the bowl is capable of treating, otherwise excess of butter-fat will pass away in the skim milk. The embodiment

of Notice C is, no doubt, to some extent, the cause of much heartburning and discontent at creameries, factories, and dairy farms. Irregularity in the turning of the separator will soon show itself in the butter-fat tests of the cream. Young people are entrusted with this important duty, and, without knowing the gravity of the work, do not drive the separator at a steady speed, whereupon the inflow of milk is not sufficiently exposed to centrifugal force to effect a proper separation of the cream.

Notice D.—In separating, the operator should be particular to keep a continual flow of milk passing into the bowl, and not stop or slacken speed because the receiver is empty. Separating should be conducted so that the receiver is never permitted to exhaust itself, and this will reduce the possibilities of loss.

Notice E.—When water or skim milk is run into the machine before and at the close of working, the percentage of butter-fat in the cream will not suffer, as believed. Care should be devoted, however, to the addition of regular quantities of skim milk, which is preferable to water to remove the cream adhering to the plates or inside parts of the bowl when separation is finished.

Notice F.—As every owner and those engaged in the working of separators know that altering the screw or regulator causes a variation in the thickness of the cream, it should not be practised except when there is a just and reasonable cause given.

Notice G.—In hot climates, the author would recommend that the proportion of fat in cream should not be lower than 30 per cent., and not higher than 40 per cent. In the hot months of the year thin cream churns readily in transit to the factory, making it impossible to obtain a true sample for testing purposes. It might also be mentioned that, in this quality of cream, whey is quickly produced from the excessive quantity of milk contained in the product, and which has a most hurtful effect on the butter.

Notice H.—To prevent cream from adhering to the discs of the machine and other parts of the bowl and escaping in the skim milk, it is recommended to run a small quantity of warm water through the separator before the addition of the milk.

Notice I.—Separators must be thoroughly cleansed of the bad smelling slime immediately after working, and not allowed to remain in abeyance until a "convenient" time during the day or shortly before use again. To disregard to wash and scald the bowl and its parts morning and afternoon when separation is conducted after each milking, under the belief that once a day is sufficient, will occasion heavy losses of cream, and the development of hurtful flavours will immediately begin in the product.

Notice J.—When quantities of colostrum are separated, slime soon accumulates in the bowl, and retards efficiency of the working parts of the separator. "New milk," as most are aware, contains a high percentage of solid matter, having a sticky consistency, and

possessing an offensive smell when left exposed to the air for an hour or two in warm weather. It is, therefore, reasonable to expect that grave dangers to the quality and keeping properties of cream arise from want of care in this direction. It should be recorded as a serious offence for any dairyman to use milk from newly calved cows until the high colour and peculiar smell have disappeared. In some instances these characteristics can be traced in milk up to fourteen days from the date of calving, and even longer.

Notice K.—When milk is preserved and kept for hours and then separated in a slightly acid condition, although not perceptible to ordinary observation, good results are not obtained.

Important Factors in the Separation of Milk.

Do not separate into a dish or can containing cold cream. Keep each lot apart. Cool thoroughly, and mix immediately before sending to the factory. The writer would also draw attention to dairymen putting cloths on the necks of cans to keep the milk or cream from splashing out. This practice is objected to because of the unsuitable pieces of linen used, and the want of care in keeping them clean.

The writer will take the liberty to repeat rules already given, and add to their number, as it cannot be too much impressed upon all cream-suppliers the value of attending closely to this branch of the dairyman's work :—

a. Separate the milk as it comes from the cow.

b. When this is inconvenient in cool weather, heat up to 90° Fahr. immediately before separating.

c. Do not separate colostrum or beastings, neither the milk from diseased animals, nor when calving is near.

d. Do not mix cold and hot milk together, nor acid and sweet supplies.

e. Milk that is a few hours old in hot summer weather should be separated alone and unheated.

f. Have your separator firmly fixed, and all parts in thorough working order.

g. Run a little warm water through the machine before commencing to separate. Get up speed of separator before turning on the milk.

h. Regulate the inflow of milk.

i. Keep the receiver well filled throughout the whole period of working.

j. Do not alter the cream screw, excepting when absolutely necessary; skim an equal percentage of fat daily.

k. Be careful not to use too much skim milk to wash the cream out of the bowl when the separator is in motion.

l. Take the machine to pieces and thoroughly clean the inside parts at the close of each separation, and expose fully to a pure atmosphere.

m. Put the separator together immediately before use.

n. Be very careful to work at a sharp and steady speed.

o. Do not add preservatives to milk to keep it sweet for separation.

It will thus be observed that variations in the weight of cream and percentage of fat may reasonably be attributed to the separator, as the slightest derangement of the mechanism, such as clogging with new milk (colostrum) or general carelessness, lowers the efficiency of the machine as a clean and profitable skimmer. The condition of the milk, principally its temperature and freedom from acidity, requires the strict attention of every farmer to avoid a fall in the butter ratio of cream.

Experiments in the Separation of Milk.

The following will illustrate the attendant dangers in separating milk on the farm.

The machine used was a small hand-power Alpha Laval, and in each test a quantity of well-mixed milk was divided into equal quantities and treated separately. No. A was done in June and No. B in July. All precautions to ensure accurate figures were adopted throughout the experiments. The tests were worked out in duplicate, altogether 168 samples being treated to ensure a reliable average. Had the experiments been carried out in hot weather, a much greater variation in the fat-reading and weight of cream would have followed.

TEST 1. shows the marked difference in cream

percentage and yield when cream is added to milk. It will assist readers to understand that variations in cream returns takes place when the quality of milk fluctuates from day to day, caused by conditions already explained.

	Milk.	Milk.	Temperature, Fahr.	Cream.		Cream Test.
	Lb.	Per cent. Fat.	Degrees.	Lb	Oz.	Per cent. Fat.
			First Half.			
a -	26½	3.8	82	2	10	33
b -	26½	3.0	86	2	8	36
			Second Half.			
A -	26½	3.8	82	3	8	39
B -	26½	3.0	86	2	12	46

To the second half of milk A, 1 lb. 2 oz. of cream was added from *a*, and then separated. In the case of B, 1 lb. of cream was added.

No. 2.—Keeping milk over-night to be separated the following morning is shown in No. 2 test to affect the reading of the cream. This is principally caused by the development of acid in the milk, and separating at a high temperature when in that condition.

	Milk.	Milk.	Temperature, Fahr.	Cream.		Cream Test.
	Lb.	Per cent. Fat.	Degrees.	Lb.	Oz.	Per cent. Fat.
First Half.						
A -	26½	3.2	86	2	10	32
B -	26½	3.1	90	2	8	26
Second Half was kept until Faintly Acid.						
A -	26½	3.2	90	2	10	27
B -	26½	3.1	90	2	8	22

No. 3.—The addition of preservatives to milk to increase its keeping properties by arresting the activity of lactic acid organisms is illustrated in the even results in fat obtained compared with No. 2. But there is a loss both in richness of cream and weight.

	Milk.	Milk.	Temperature, Fahr.	Cream.		Cream Test.
	Lb.	Per cent. Fat.	Degrees.	Lb.	Oz.	Per cent. Fat
First Half.						
A -	26½	3.6	81	3	4	29
B -	26½	3.4	86	1	12	32
Second Half.						
A -	26½	3.6	90	3	2	27
B -	26½	3.4	90	1	8	30

To the second half, ½ oz. of "preservative" was

added. Milk was kept for thirty-six hours and separated at 90° Fahr.

The preserved cream had a bad flavour and objectionable smell in each instance. This is very important.

No. 4.—The addition of separator milk in the fourth test made no difference to the percentage of fat in the cream, although the weight was slightly increased. Alteration of the cream screw has made a well-defined change in the butter ratio of the cream.

	Milk.	Milk.	Temperature, Fahr.	Cream.		Cream Test.
	Lb.	Per cent. Fat	Degrees.	Lb.	Oz.	Per cent. Fat.
			First Half.			
A	26½	3.0	79	1	12	46
B	26½	3.2	88	2	8	36
			Second Half.			
A	26½	2.8	78	1	12	45
B	26½	3 0	86	3	0	36

One quart of separated milk was added in the case of A, cream screw of machine was altered three-quarters of a turn to increase percentage of fat and increase yield of cream. In the case of B, the screw was put back as near as possible to its former place.

No. 5.—In the separation of milk containing added

water the yield of fat was decreased by 2 per cent., but the weight of cream was not affected. It must be borne in mind that in tests Nos. 4 and 5 the addition of water was made to the milk. Had it been cream, a much greater change would have resulted.

	Milk.	Milk.	Temperature, Fahr.	Cream.		Cream Test.
	Lb.	Per cent. Fat.	Degrees.	Lb.	Oz.	Per cent. Fat.
			First Half.			
A -	26½	3.5	80	3	2	26
B -	26½	3.6	80	3	2	26
			Second Half.			
A -	26½	3.2	80	3	2	24
B -	26½	3.2	80	3	2	24

To the second half one pint of water was added. Test of milk dropped from 3.5 A to 3.2, and from 3.6 B to 3.2.

No. 6.—Forgetfulness is sometimes shown in the proper cleaning of separators, consequently the keeping qualities of cream suffer very severely; also losses are met with in the yield of butter-fat and weight of cream. No. 6 will demonstrate the danger of not attending to the care of the machine.

	Milk.	Milk.	Temperature, Fahr.	Cream.		Cream Test.
	Lb.	Per cent. Fat.	Degrees.	Lb.	Oz.	Per cent. Fat.
FIRST HALF WITH UNCLEAN SEPARATOR.						
A -	26½	3.6	86	2	8	32
The separator was worked in the morning in a dirty condition, not having been cleaned after the previous evening.						
SECOND HALF WITH CLEAN MACHINE.						
B -	26½	3.6	86	2	8	34

Fat Percentage.

Skim milk A slightly less than 0.1 per cent.
Skim milk B Trace.

The attention of owners of separators should be drawn to the loss of fat in the skim milk, and to observe that the second half of the test showed the virtue of cleaning the separator immediately after working.

No. 7.—Carelessness in turning the separator is responsible for grievances by dairy farmers in their dealings with the factory. We have proof of the evil in the figures to follow :—

	Milk.	Milk.	Temperature, Fahr.	Cream.	Cream Test.
	Lb.	Per cent Fat.	Degrees.	Lb. Oz.	Per cent. Fat.
	First Half—Careful Turning.				
A	26½	3.4	86	2 6	44
	Trace of fat in skim milk.				
	Second Half—Irregular Turning.				
B	26½	3 4	86	2 8	36

Percentage of fat in separated milk of second half, 0.1. Numbers 6 and 7 were checked several times to ensure reliable results.

Other Important Causes.

We arrive at a stage that should command the thought of all cream suppliers, and that is the age of and the mixing of cream and conveyance of same to factories. To this department of work we attribute a heavy waste in butter-fat, and it is to be regretted that many lose sight of the agencies that are acting injuriously against the butter-fat yield of the cream. Let the remaining portion of this chapter be intelligently studied until each factor explained is clearly understood. When this is done the veil will be removed from the eyes of those who have been labouring under a misconception of the truth surrounding the "mystery" of the variability in the butter return of cream. The writer will refrain from entering into the charges

that have been made against butter manufacturers, as he sympathises with the farmers and manufacturers alike, on the grounds that there are circumstances and conditions existing which are unfavourable to both parties.

Age of Cream.

The ripeness or degree of acid is a responsible element in the butter-fat ratio of cream. If the percentage or quantity of acid is high, churning will be quick, and the risks of fat escaping in the butter-milk greater, compared with cream that contains an average proportion of acid. Proof of this will be found in the table to follow, which illustrates twelve successive tests made at a factory by the writer :—

Percentage of Acid in Cream at Churning.	Percentage of Fat in Butter-milk.	Temperature of Cream at Churning.	Percentage of Acid in Cream at Churning.	Percentage of Fat in Butter milk.	Temperature of Cream at Churning.
0.89	0.4	56°	0.56	0.2	56°
0.80	0.4	57°	0.57	0 2	56°
0.88	0.6	58°	0.57	0.2	56°
0.90	0.6	59°	0.57	0.2	56°
0.84	0.5	57°	0.55	0.2	56°
0.84	0.6	58°	0.55	0.3	55°
0.63	0.3	55°	...	...	...

Best results usually follow a lower percentage than 0.55.

From these figures it will be gathered that the losses in fat increased when the acid exceeded 0.57 per cent., and this is more pronounced when the temperature of the cream at churning is high. In other

experiments it was found that cream with 0.85 per cent. and 0.90 per cent. of acid did not lose much of its fat when the churning temperature was kept as low as 50° Fahr. in warm weather. The above illustration, however, was not taken from suppliers' quantities of cream, but from cream separated in the factory, other-

Sample of cream which was kept standing for three days. Whey has separated from the cream, which is a condition commonly met with in the cream supply of warm countries. The illustration will serve to show the grave danger in the treatment of aged supplies of cream.

wise the fat losses would have been heavier, caused by want of uniformity in ripening and greater age, which are conditions usually found in the farm-separated product. It must be accepted by farmers that age of cream seriously affects the butter returns, and what must the waste be in some cases where cans of cream

are sent many miles by road and rail and exposed to scorching heat for hours? The bacteriological and chemical changes that are produced, and which need not be explained here, work disaster in the body of the product to an extent that refrigeration fails to save the costly fat from passing away in the buttermilk.

CHAPTER II

FAT TESTING OF MILK AND CREAM

THE practice now being followed to estimate the butter-fat value of milk and cream, is one which claims an honest basis, but whenever science opens up new avenues, there follows the possibility of mistakes and wrong-doing. The appliances recommended, and the methods suggested in this work, are in many instances new to students of dairying, and it is hoped that through a practical application of the instructions given, the industry will benefit to the extent that is heartily desired.

ADVANCED METHODS IN AUSTRALIA AND NEW ZEALAND.

The suitability of Australia as a dairying country, and the phenomenal development of all branches of the industry, have called for the introduction of modern methods in the treatment of the raw and manufactured produce of the dairy. Great innovations have been made in the subject of fat testing and grading, and the State of Queensland was the first in the Australian Commonwealth to make compulsory the purchase

of milk and cream by factories on a butter-fat basis, also it is insisted upon by the same State that no person shall determine the quality of milk and cream unless duly qualified by the Government. Legislation of this kind has been of immense benefit to the industry, and has enriched farmers to the extent of thousands of pounds, as well as having been a means of preventing heavy losses amongst factories and dairy companies. To Queensland also is the honour of standardising all glassware for use in the butter-fat testing of milk and cream, and in appointing inspectors to watch the interests of dairymen in the disposal of the raw produce of the farm, and to teach them the most up-to-date means of ascertaining the true value of their produce.

Testing of Milk on the Farm.

It has been repeatedly urged that dairy farmers should study the milk-producing properties of the cows in their herds. Equipped with the Babcock test the farmer can do this at a trivial cost, and by care grade his herd to a class of creditable milkers. The Babcock test estimates the percentage of fat in the milk, and to successfully manipulate the apparatus no difficulty need be feared by the practical man. The value of the test to the dairyman will be gathered from the following advantages which can be derived from its application :—

a. Guide to systematic dairying.

b. To determine the profitable from the unprofitable cows.

c. Aid to milking and breeding.

d. Application of the test in the education of juvenile milkers.

e. Value of food demonstrated.

f. Carelessness in milking, as want of efficient stripping and other injurious and unprofitable practices, illustrated.

g. Proof that the exposure of cows to cold weather and summer heat reduces the butter-fat percentage.

h. A check against the adulteration of milk after it leaves the farm or milk-shop.

i. Value of the test in conducting breeding experiments.

Since these advantages accrue from the application of the test, dairy farmers will agree that much hard-earned money has been lost through the keeping of inferior milk cows, and breeding from same, whilst serious mistakes have been made from want of information under the headings enumerated above. The writer would strongly recommend to every farmer to procure a simple tester, and from time to time apply it to each cow on the farm. It is a wise policy to follow, and it will pay handsomely when all things are considered. We know well in practice that the yield of milk and pounds of butter-fat that a cow gives in a year is no guide to the producer as to the amount of food consumed. In many instances the poor milk cow is a ravenous eater, and it is not uncommon to find her lean in body, and lacking in

constitution. And there is the danger to her progeny for milking and breeding purposes, for she cannot be depended upon to produce profitable stock for the dairy.

The author's campaign to popularise the systematic testing of cow's milk began in South Australia fourteen years ago. From the outset it was recommended that dairy cows should be sold in the open showyard, with an authentic milk record. Steadily the value of testing became apparent, and the author has much satisfaction in reviewing the very advanced position Queensland now occupies in this important branch of dairying.

Caution to Suppliers.

The author has drawn the attention of the reader to the fact that wherever a progressive step is made, there is always danger of error arising through its adoption. The testing of cows by the farmer, and the testing of milk and cream at factories and other institutions must not be put on the same parallel; as where payment is made on the fat test, or absolute accuracy is desired, a certificated tester only should be relied upon.

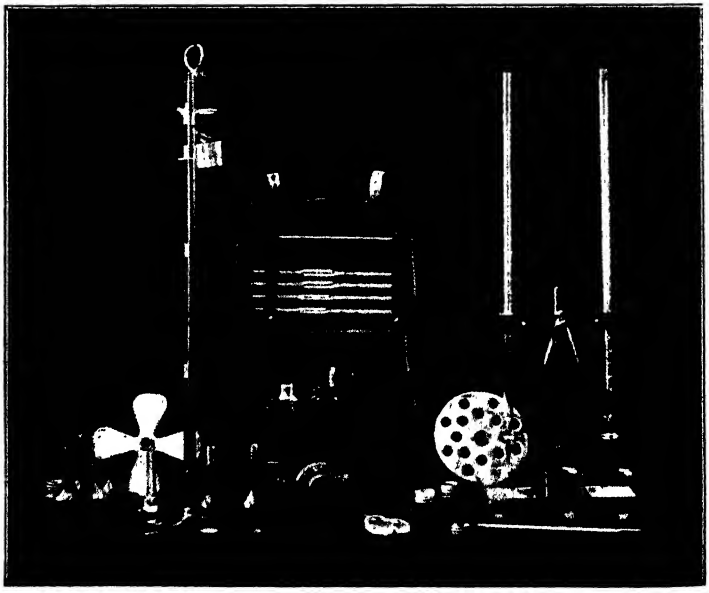
Testing-Room and Outfit for Schools, Creameries, and Factories.

It should be the aim of every person who is responsible for testing to provide a complete outfit, and to conduct the work under the best conditions. One too often finds the testing-room unsuited, being

either cramped for space, badly constructed, or dimly lighted. Money should not be grudged to thoroughly equip and maintain these departments where such valuable and important work is carried on.

The following is a list of requirements for testing :— Tester, plunger and sampler, cream and milk mugs and mixing dishes, water bath, waste water dishes, wooden stirrer, pipettes, thermometer ; whole milk, skimmed milk, and cream test bottles ; acid and measures, muslin, compass, formalin, bichromate of potash, ether, black enamel and brush, soda and cleaner.

For the dairy farmer a simpler outfit than is shown is necessary.



MILK AND CREAM TESTER'S BABCOCK OUTFIT.

How to Take the Sample of Milk.

In milking, the cow must be stripped thoroughly and the milk strained, and well mixed from vessel to vessel. After a few minutes have elapsed a quantity of milk should be taken from different parts of the vessel and following a slight shaking delivered into the sample bottle. At this stage it is recommended to take the temperature of the milk and record same in the schedule, which is provided for the purpose. No delay should be occasioned in submitting the milk for testing purposes, otherwise difficulties will be met with which might act harmfully against the accuracy of fat reading as the following will show.

Test made from Top, Middle, and Bottom of Sample.	Sample of Freshly Drawn Milk Plunged into Cold Air and Tested Two Hours after Milking.	Sample kept at Atmospheric Temperature of 75° Fahr. for Eight Hours
	Fat, per cent	Fat, per cent.
Top	3·9	3·75
Middle	3·6	3·70
Bottom	3·5	3·65

For accurate work it should be insisted upon to record the age of the milk temperature, also the density and acidity of samples, for to each some value is attached, as will be seen later. This of course would apply more to the testing of milk by qualified inspectors.

Preserving the Sample for Weekly or Bi-weekly Tests.—Composite bottles are used by milk depots and butter and cheese factories in which

the glass bears graduation marks each representing one sample. Usually at the end of the week the bottle of milk is thoroughly shaken, and a test made of the six days' supply. In taking the samples, what is known as the drip system is generally used.

Preparatory to receiving samples all bottles are carefully washed and dried, and from two to three drops of formalin are added to each. The bottles are now ready for the milk, and upon addition of the sample care is taken to mix milk and preservatives thoroughly, otherwise the chemicals would fail to act equally throughout the body of milk. In the treatment of acid samples it is preferable to add a small quantity of bichromate of potash, as its preserving properties in the presence of lactic acid are more marked than formalin. When samples from individual cows are tested, difficulty will sometimes be met with in cases where the milk shows indications of coagulation. In instances of this kind the addition of ether, regulated to the acidity or coagulated condition of the sample will liquefy the milk sufficiently to make a test for ordinary practical purposes. On the farm, however, this should not be necessary, as all that is required to ensure a thoroughly sweet supply of milk is within the scope of every dairyman.

It is well to point out that coagulation may be at work in milk, without any ocular evidence, even the fluidity of the sample might not betray a thickening condition. Where this happens accuracy in estimating the fat with an ordinary milk tester cannot be depended upon, as the following shows :—A quantity of milk was

exposed to the air of a warm room. It was tested for fat every hour until the milk coagulated.

	Fat, per cent.		Fat, per cent.
1st hour	4.1	7th hour	3.6 and 3.7
2nd ,,	4.1	8th ,,	3.6
3rd ,,	4.1	9th ,,	3.5 and 3.7
4th ,,	4.0 and 4.2	10th ,,	3.9 and 4.0
5th ,,	3.9	11th ,,	3.7 and 3.9
6th ,,	3.8 and 4.0		

The action of the acid on the milk and the colour of the fat column showed that changes were at work in the product. This was brought about by the increasing proportion of lactic acid, and the liberation of whey and the congestion of the fat globules caused an uneven distribution of fat in the milk.

Making the Babcock Test.

After a thorough and careful mixing, a 17.6 c.c. pipette, which is perfectly free from all traces of foreign matter or milk and absolutely dry, is used to measure the quantity for testing. By the action of the mouth the milk is drawn to the mark in the stem of the pipette, care being taken not to exceed or under-measure the correct proportion. The milk which should be absolutely free from air bubbles, is carefully delivered into the test bottle, 17.5 c.c. of sulphuric acid is now added, care being taken not to burn the milk solids at this stage of the test. The mixture is shaken in the manner prescribed for cream

testing, after which the bottles are placed in the tester, and whirled with as little delay as possible. Five minutes is given to this, when water at a temperature of about 190° Fahr. is added to the zero mark in the bottle. The machine is again set in motion for two minutes, at the conclusion of which more hot water is added to bring the fat to a space in the neck where it can be easily read. A final running for one minute makes the separation complete. After the column of fat is measured by the compass the lower pointer is placed at the 0 mark, and the distance between this and the upper pointer will give the percentage of fat.

In connection with the above subject a good deal more might be said, but as cream testing will be dealt with exhaustively, what has been omitted of importance will then receive the attention it deserves.

Milk Records.

Much has been written about milk records, which the writer is an ardent believer in, but enthusiasts have gone far to hold up to ridicule some of the greatest virtues of the practice. They have gone so far as to recommend the purchase of cows on the basis of a few tests, a proposal that embraces many grave risks, as this treatise will show. If cows are to be bought or sold on the fat ratio of their milk the work of testing should be carried out on the farm by independent persons, who are specially qualified and experienced to give authentic results, and upon whose figures confidence may be placed. After a systematic course of weighing and testing, the average for the season or part

of a season should be taken, and this should be considered with other important features before a value is placed upon an animal on the basis of its milk supply.

The following may be taken as a simple record chart :—

Test made on Mr .....'s Farm of .....

By .

Name of Cow.	When Calved.	When Served	Date of Fat Testing and Weighing.	Temperature of Milk.	Per cent. Fat.	Weight: Milk in lbs.	Acidity of Milk.	Remarks
					M. N E.	M. N. E.		

Cream Testing.

In a previous publication the writer gave a review of an investigation he conducted to ascertain the causes of losses in the testing of cream in Australia. This was prompted by very serious discrepancies found by factories to exist between the churn results and the fat readings of cream supplies. It fell to the writer to conduct a practical and scientific inquiry into the question, and although it was a huge undertaking, it well repaid the country for the cost of the investigation. The results showed how momentous and deeply rooted were the errors in all branches of testing, and the only effective way found to deal with the question was by the introduction of common-sense legislation. Happily

this proved eminently successful in putting the testing of milk and cream on a foundation of security and honesty.

Since this was accomplished numerous solicitations have been made to the writer to issue a work giving in practical language a complete review of the system of testing which was adopted in connection with the Government examinations under his control. This system has been shown to be thorough, and in keeping with the science and practice of dairying. It differs in many respects from that recommended by writers on the subject, but it is to be hoped the innovations will commend themselves to the average student and factory hand.

The Sample.

This is an operation of the most vital importance, and the most dangerous from a point of error in the testing of cream. In the majority of cases inaccuracies are attributed to want of care in taking the sample.

Let it be asked what condition of cream will satisfy an operator that it contains an even percentage of fat. He will answer that the cream must be sound, of an even consistency, and at a correct temperature. These might be called the component factors, which give to cream the physical properties that are necessary to an accurate butter-fat test.

There is an element in the above of special significance to the factory and farmer, and it is one that has been neglected most—namely, the simple process of stirring or mixing the cream. Consider what takes place in a can of cream that has remained undisturbed

for a few hours. There is a rapid separating of the constituents, the water substances fall to the bottom, the fat rises to the surface and its power of adhesion increases with time—all adding to the difficulty of obtaining a reliable sample. The effect of this change is more marked in the winter months when cream is kept for days. In such cases the fat will be fixed in layers, which will make a thorough mixing of the layers and particularly the solids a matter of difficulty.

The illustrations herewith given will show what grave mistakes have been made through an absence of attention in this direction. Again, let it be considered what changes take place in supplies of thin cream in warm weather, and when it is carted or railed many miles. The fat globules will coalesce, forming granules of butter, and when these are partly formed or in a state of fine division they are not noticeable to the naked eye; and, to make matters worse, there is a different degree of churnability in the layers of cream which increases the difficulties of obtaining a true sample.

From what has been said, supported by the illustrations, the practice of taking samples with a cup-dipper or stick should be vigorously condemned by every factory.

The writer would, therefore recommend that the samples be taken after the cream has been treated in the following manner:—

A. Poured from one can to another (mixing can).

B. Carefully mixed with plunger.

C. Sample taken with approved tube or syringe.

Pouring from one can to another is not always necessary, but in the case of aged and set quantities of cream it should be insisted on so as to destroy the strata or layers which the cream separates into. These layers, as has been shown, vary very considerably in the fat percentage.

Fat Percentages in Cream.

The following shows the percentages of fat in cans of stirred and unstirred cream. The samples were carefully taken by means of a syringe:—

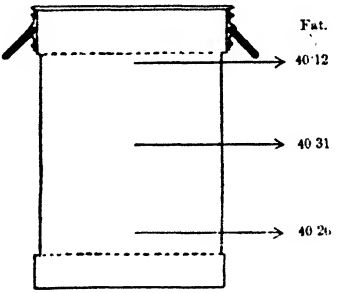


Fig. 1.—Sweet, Fresh Cream.

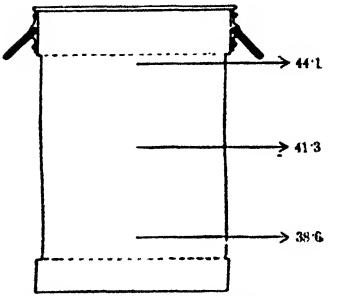


Fig. 2.—Same Cream undisturbed for 18 Hours.

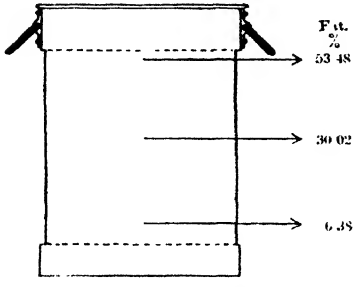


FIG. 3.—Aged Cream before Stirring.

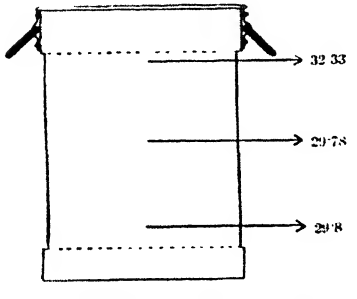


FIG. 4.—After Stirring for 3 Minutes with Cup-dipper.

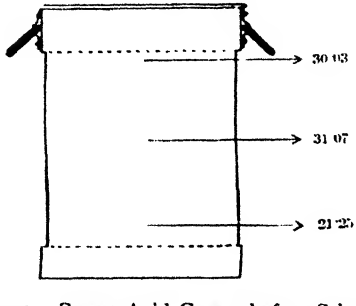


FIG. 5.—Sweet Acid Cream before Stirring.

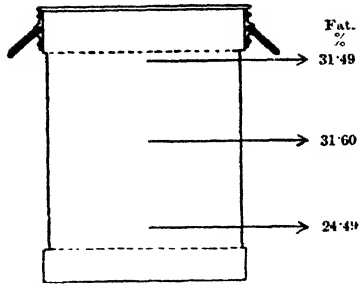


FIG. 6.—After Stirring for 3 Minutes with Cup-dipper.

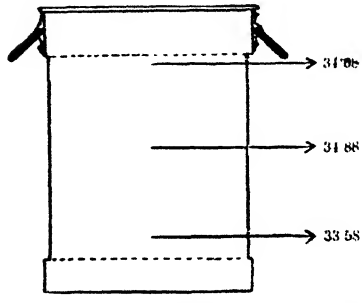


FIG. 7.—Sweet Cream of Good Consistency before Stirring.

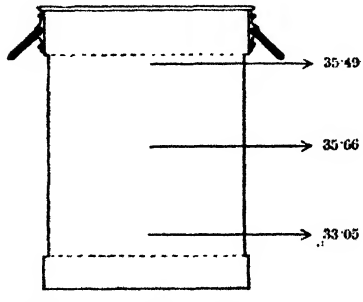


FIG. 8.—After Stirring for 3 Minutes with Cup-dipper.

These figures show that when cream is kept too long great difficulty is experienced in getting the top layer to mix with the other parts (Figs. 3 and 4). This is caused by the top forming a sort of cake.

Figs. 5 and 6 illustrate the danger of using cream that is too thin, as the excess of milk which coagulates at the bottom of the can will not mix with the other parts.

Cream of 35 per cent. fat (Figs. 7 and 8) makes the best condition in the cream for taking a correct sample under the system of delivery in the majority of oversea dairying countries. In this consistency of cream there is a better balanced body of fat, casein, and other solids, which have a greater resistance against the changes which are hurtful to the physical condition of the cream.

The common way of mixing the cream before taking the sample is to use the cup-dipper, which the writer has already condemned; also the stick is a favourite "measure" with some factory employees. The following illustrations afford sufficient evidence of the evil of this practice.

Cans and Mixing the Cream.

The general practice is to take the sample from the can used in collecting the cream from the separator. Unless the cream is fresh and sweet and of even consistency, the stirring that it usually gets will give inaccurate results in testing. Narrow-mouthed cans should be got rid of by the farmer as expediently as his finances will permit, and the large open-mouthed

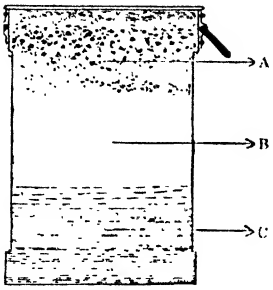


FIG. 1.

A. Partly Churned.
B. Liquid Cream.
C. Coagulated Milk or a Watery Product, according to Age and Quality of Cream.

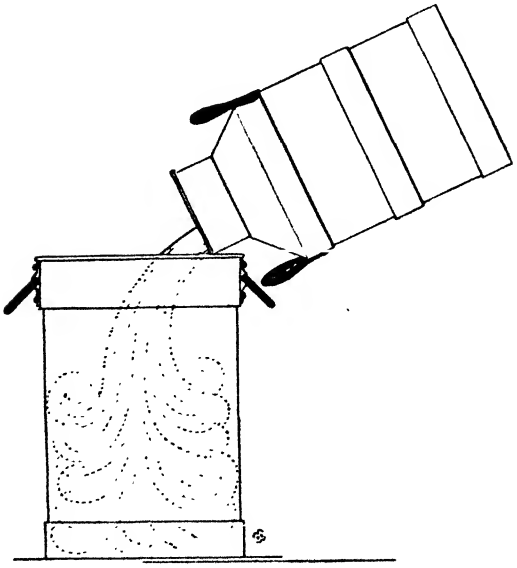


FIG. 2.

design substituted. This can is more suited to give better aeration to the cream, and it can be more perfectly cleaned, but the factor to be considered here is the more thorough blending of its contents before taking the sample for fat analyses.

It has already been explained that an acid product which has been left undisturbed for hours soon gives rise to a change in the butter-fat ratio of the cream. To mix properly, the cream would require to be tipped into another can and treated with the plunger as already stated, after which it would be returned to the original vessel, and the sample taken.

Diagram 1 shows the condition of large quantities of cream during the hot weather, and from which samples are collected for testing purposes. No. 2 illustrates how the mixing should begin.

Testing a Can of Cream after the Use of a Stick and Plunger.

No. 1 diagram illustrates the uneven percentage of fat in the can of cream before stirring.

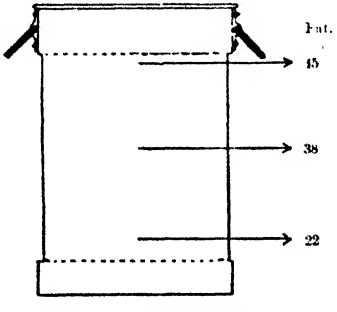


Fig. 1.—Unstirred Cream.

No. 2 shows the absurdity of trying to mix the cream with a stick and obtain a sample for a reliable estimate of its fat content. It will be seen that the action of the stick causes the cream to move with a circular motion, but not to mix. A sample of cream was taken by the stick in the manner practised at some factories. It showed an error of 6 per cent. of fat.

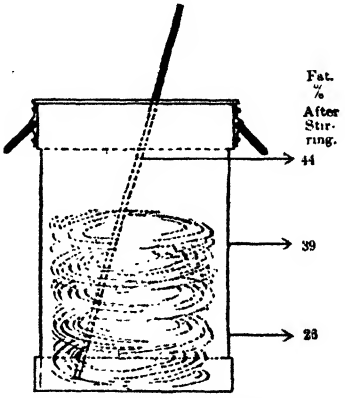


FIG. 2.—Showing Action of Stick in Cream.

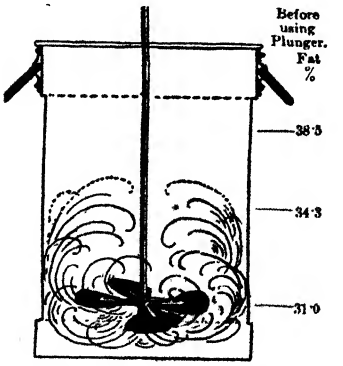


FIG. 3.—Action of Plunger.

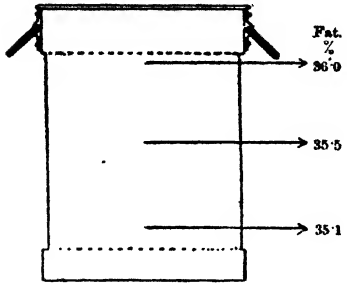


FIG. 4.—After Stirring with Plunger.

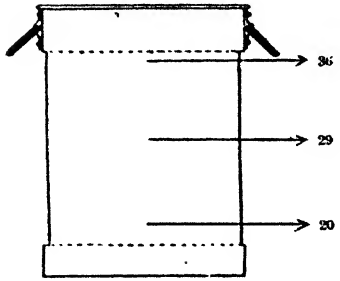


FIG. 5.—Before Stirring.

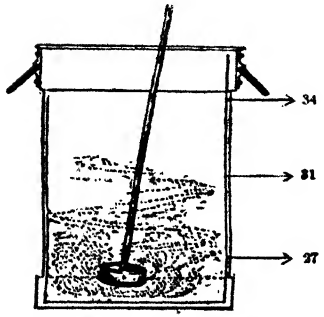


FIG. 6.—After Stirring with Dipper.

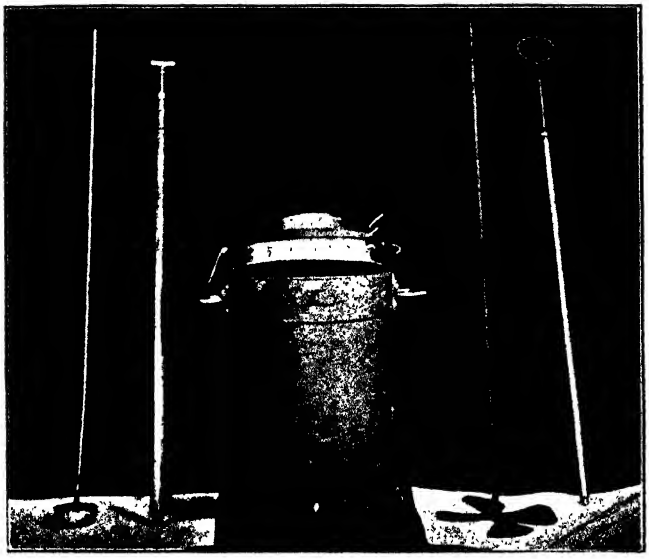
No. 3.—In using the plunger, readers will note from the illustration how it acts in the cream, forcing it to move in opposite directions. The plunger, which is made of steel, has convex and concave blades, so that either side will operate against the resisting body of cream and compel it to mix. There are openings between the blades to relieve the tension caused in manipulating the plunger.

No. 4.—The satisfactory mixing of the cream is borne out by the fat test.

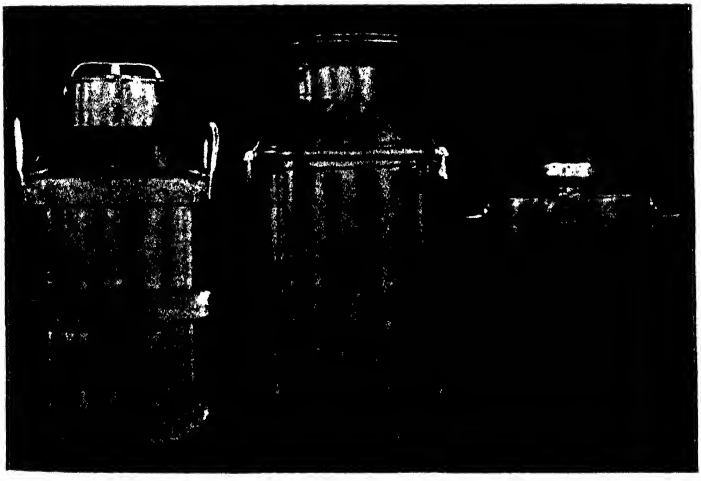
No. 6.—The defects in this method of stirring with a cup-dipper and taking the sample are evident.

How to Take the Sample.

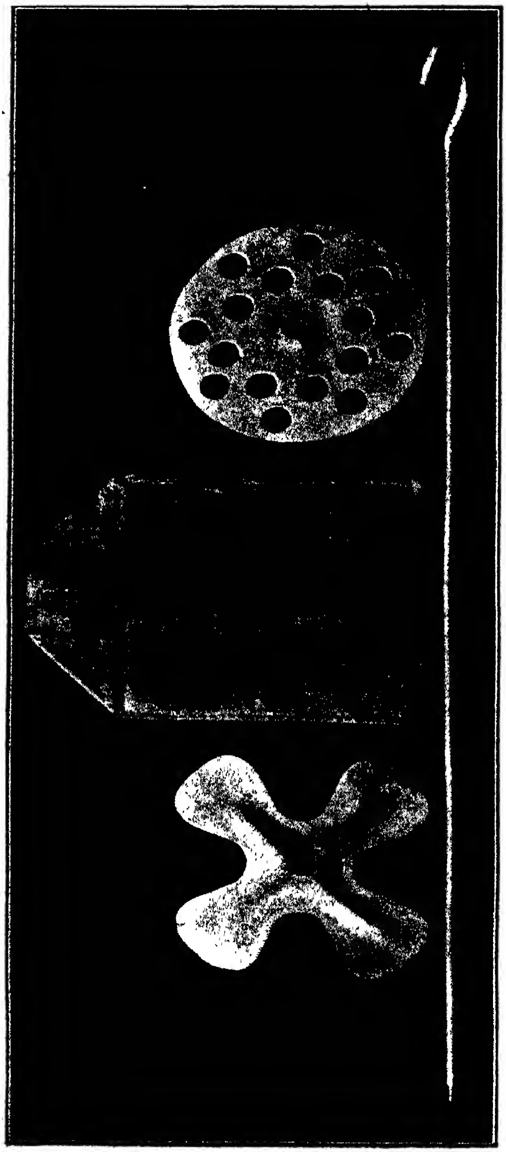
Having dealt with the preparation of the cream for the taking of the sample, and the best methods to be employed, our next step is to explain how the sample should be taken. This is done by means of the tube or syringe which has a capacity of one complete sample. The syringe, for example, should be handled in such a way as to draw the cream from different parts of the can, the contents of the syringe being discharged into the sample measure. Arrangements should then be made to keep the samples cool, which makes the testing all the less difficult, and the more accurate. In the case of cream travelling considerable distances, a gassy or spongy condition is frequently found in the samples which cannot be overcome in after-treatment. Under such conditions the addition of bichromate of potash to preserve the cream is recommended (see bacteriological illustrations).



Dipper. Tube. Cream Can (Seamless). Plunger. Syringe.



Inferior Can Seamless Steel Can. Seamless



Complete Cream Plunger used for Mixing Cream in Cans immediately before taking Samples for Fat Testing, also for use by Cream Suppliers.

A Simple and Effective Sample Measure.

There are quite a number of measures used by factories for collecting samples of cream for fat testing. Some are well adapted for the purpose, while others show nothing to commend them. Still no objection is raised by the farmer against their use. It is recommended that the kind of measures necessary to accurate testing should be made from clear glass having a metal-top which screws on to the bottle. The good features of this bottle are its simple construction making it easy to clean. If this is not sufficiently done, it can be very readily detected through the glass. The bottle has also the advantage of showing fermentation in the cream by the appearance of air bubbles, and other conditions commonly met with in the hot weather. Small space is required for this sample measure, and the cream can be quickly heated or cooled for testing. The tin measures are not to be recommended, for reasons which require no explanation.

Mixing the Sample.

In samples which have not received proper attention or have been carried long journeys by road or rail in hot weather, lumps or clots of cream are commonly found in the samples. These should be treated with a wooden spoon to break them up before the flasks are placed in the bath. When the temperature has been adjusted to the proper degree, the cream should be mixed by pouring from one vessel to the other to ensure an even distribution of fat.

The mixing beaker should be washed clean, and dried after each sample has been treated.

Bath and Thermometer.

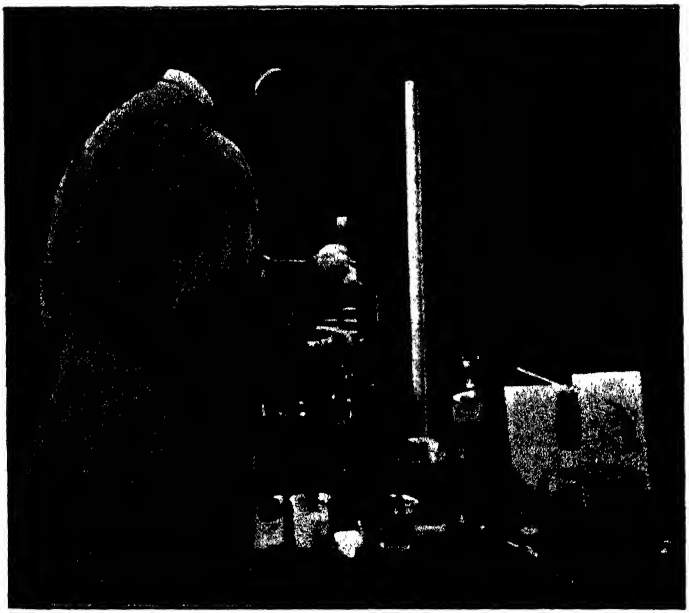
In the cool months of the year when the consistency of cream is thick and the temperature low, the advantages of heating are specially marked, and on no occasion should testing be done until all samples are brought to one temperature, preferably 70° Fahr. The writer has shown in a series of simple experiments the effect of varying degrees of heat and cold on the physical properties of cream, and which are illustrated by the differences found in the fat readings. Again when samples show particles of butter-fat floating in the cream, and adhering to the sides of the dish, as frequently happens in the hot weather, the warmed samples should be tipped from one dish to the other in a speedy manner. In such cases it is also recommended to add a little ether, and this is attendant with specially good results in the testing of "fatty" milk. At the same time let it be understood that when cream or milk is in a partly churned condition, true fat tests cannot be depended on, owing to the coalescence of the fat globules.

In systematic testing the thermometer should be used at each stage throughout the process, and no liberties should be taken with it when accuracy in detail is so essential to success, as it will be found here.

The cream is now ready for the pipette.

How to Manipulate the Pipette.

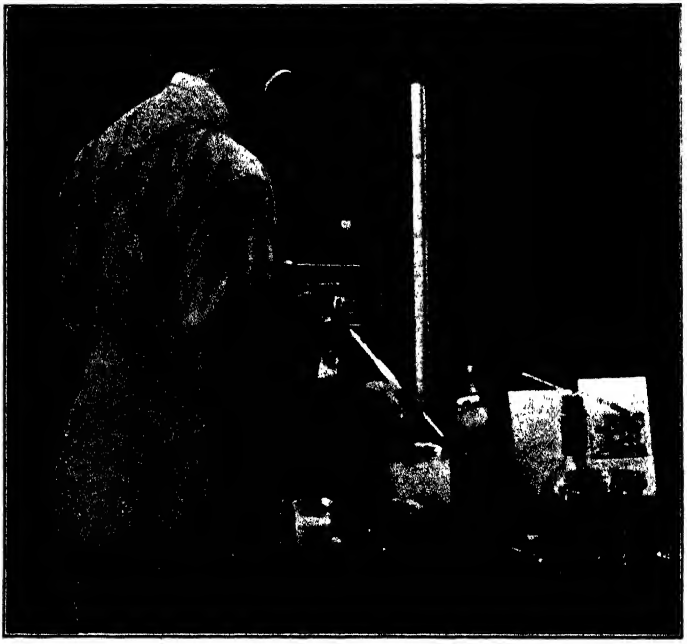
Before a pipette is inserted in a cream measure it should be blown with the mouth so as to expel any moisture that might have lodged in the inside of the glass; this should be repeated very gently after the



An example of how Cream should be added to the Test Bottle.

pipette is put into the cream. In taking the sample the operator draws the cream from different parts of the measure, the pipette being kept in motion all the time. A little more than the required amount is taken, say a quarter of an inch, and by a circular movement of the

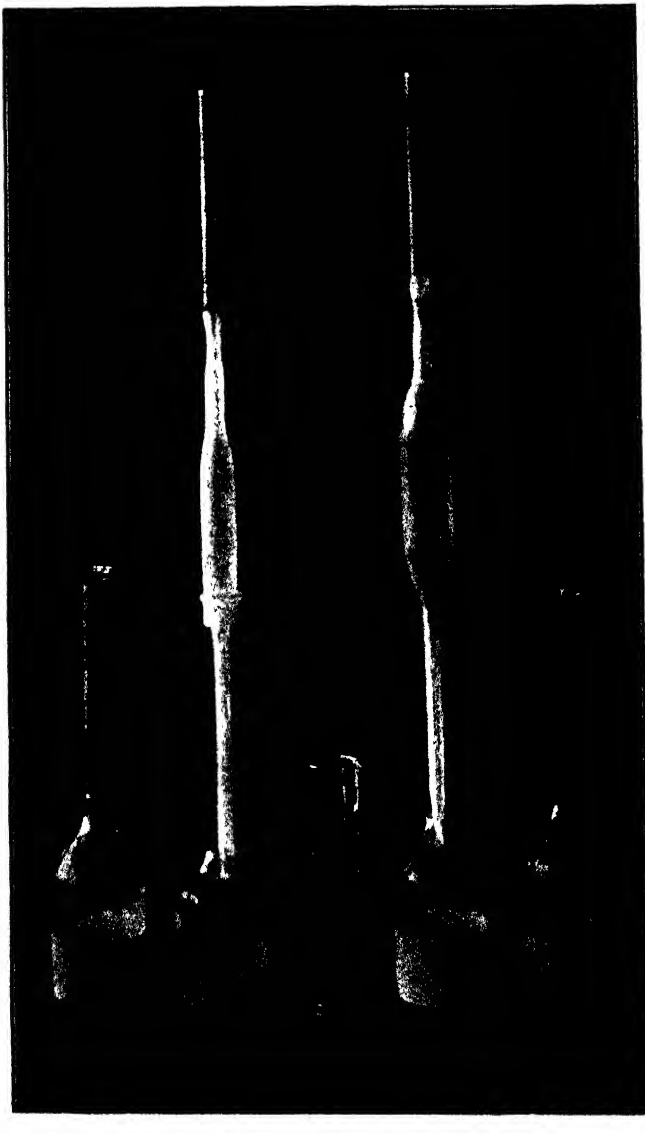
thumb the cream is gently lowered in the neck of the pipette, great care being taken not to exceed the correct measurement. Daily practice will quickly make the cream tester proficient in the manipulation of the



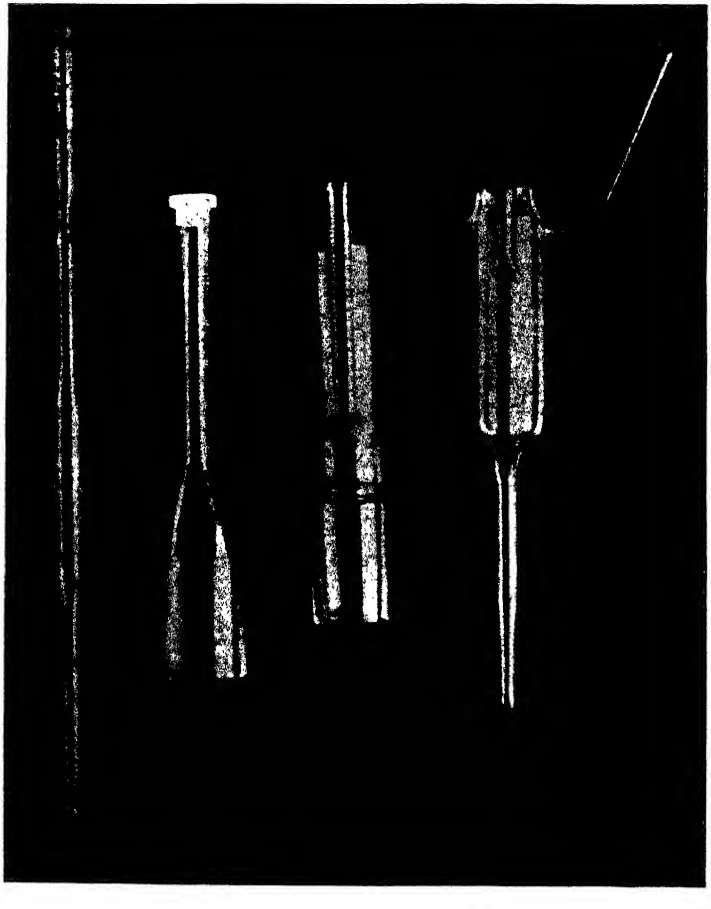
Bottle in operator's left hand contains measurement of cream. Note the absence of cream from the neck and shoulder of the bottle.

pipette, and remove the possibilities of error in delivering the correct proportion of cream into the bottles.

When the pipette contains the exact measure of cream, the point should be smartly run through hot water, to prevent the adhering cream from forming a drop and falling into the cream bottle, which would

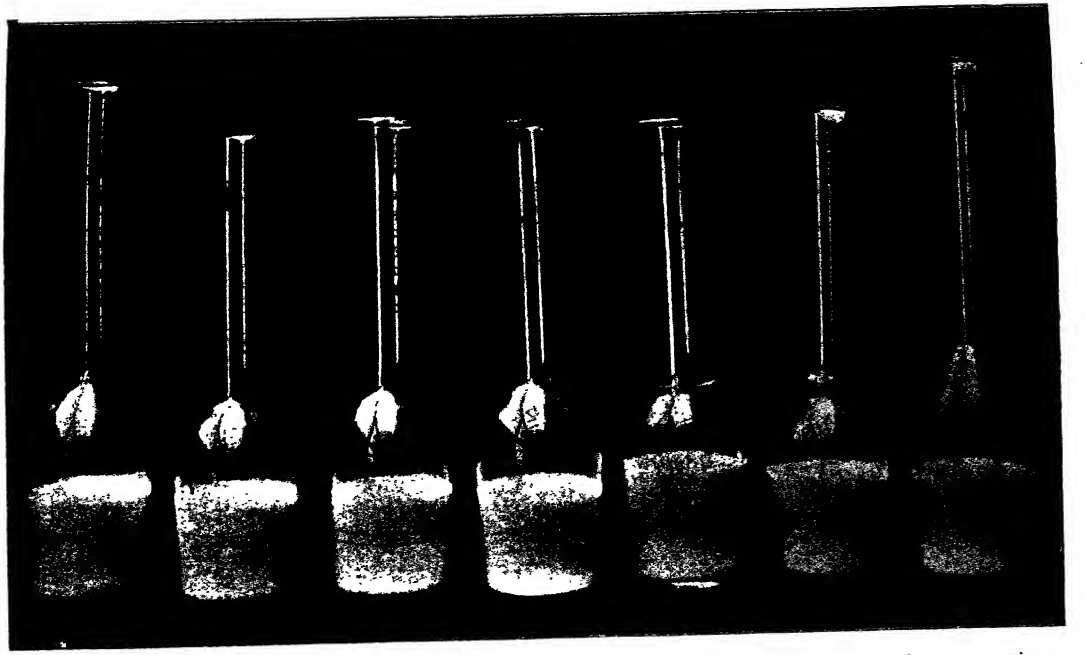


Delivering Milk and Cream into Test Bottles. Points of the Pipettes are seen beneath the shoulders of the bottles.



Babcock. Russian.

Pipettes and bottles used in the Babcock and Russian machines.



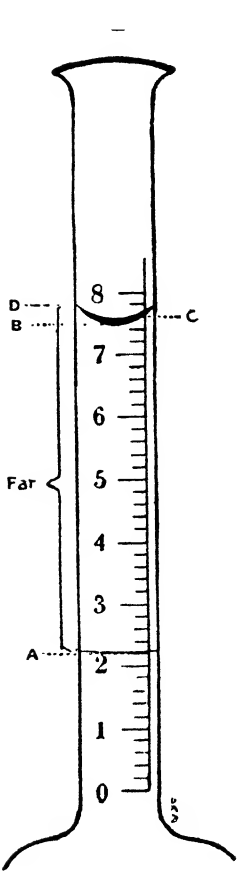
Measured Samples of Cream which were left undisturbed in the Test Bottles for twelve hours, showing a separation of the Cream in layers of fat, casein, and whey.

happen on many occasions, or it might just be sufficient to unite with cream at the point of the pipette and aid in the loss of a small proportion of the measured quantity.

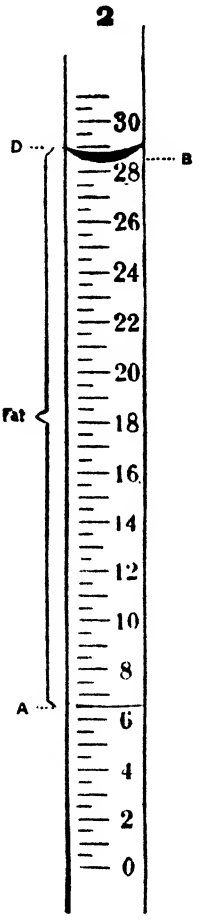
After passing the lower stem of the pipette through warm water as directed, the glass is dried by means of a small piece of linen which is held in the palm of the left hand. The cream bottle is now taken in the same hand, and with the guidance of the thumb, the pipette is smartly placed in the bottle without touching or discolouring the inside of the neck. With the point of the pipette reaching below the shoulder of the bottle, the cream is quickly delivered by the aid of the breath, followed by quick successive breaths to force the adhering cream in the lower part of the pipette through the aperture. In effecting this the lips should be released each time air is taken in through the mouth, afterwards closed on the glass, the operation taking only a few seconds. With the mouth still on the pipette, a quick breath is drawn to retain the drip at the shoulder of the stem, otherwise cream would be lost after removal of the pipette. Next place the thumb on the top of the pipette, and remove it instantly from the bottle, turn the pipette one-third over to retain the drip, and remove the thumb. When properly manipulated the pipette should be free from all traces of cream on the outside, likewise with the inside of the neck of the bottle. Holding the pipette at a slight angle, it is put into hot water—summer temperature 115° Fahr.; winter 200° Fahr.—and as the water is being drawn in, the

pipette should be brought to a perpendicular position to facilitate the action, and to leave a division between the diluted cream and the pure water.

When removed, and the stem cleaned, the pipette is vigorously shaken backwards and forwards, and returned to the cream bottle in the same manner as already described. As the contents begin to escape from the pipette particles of adhering cream may be washed from the glass by the action of the mouth drawing the wash water up and then forcing it down, this being repeated with energy, until no trace of cream is left. Continuing the test, the cream bottles are shaken to mix the cream and water, and if the tester has done his work thoroughly, no appearance of cream will be noticeable above the shoulder of the bottle. The bottles are now ready for the acid, and as each is raised from the table it is again shaken, this being found necessary, as the separation of cream and water is very rapid when the bottles are left standing. The requisite quantity of sulphuric acid is now measured, which is poured down the side of the bottle forming a distinct and independent layer, showing little or no discoloration at the junction of the cream and acid. The bottles are treated in a way hereafter explained, causing the discoloration of the cream to take place evenly and equally throughout. (See Errors in Cream Testing.) When the whole body is brown the shaking may be made more severe, care being taken that the mixture of acid and cream does not come into contact with the neck of the bottle.[1] (See Irregularities in the Fat Column.)



Graduated Stem of Milk Bottle. Read from A to D.



Graduated Stem of Cream Bottle.

The bottles are now placed in the tester and whirled at the necessary speed for five minutes; water at a temperature of 190° Fahr. or thereabout is added to

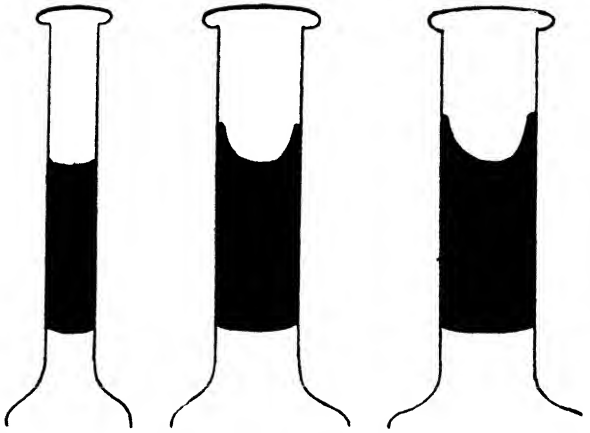
the zero mark, the machine is again set in motion for two minutes, more water is added, so as to bring the fat into the graduated column, and after whirling for one minute more the fat per cent. is read by means of a delicate compass. As soon as this is done, the bottles are immediately emptied and rinsed with warm water, afterwards washed with a hot solution of soda, and finally treated with a brush to remove any traces of fat from the neck. Pipettes should be cleansed immediately after each operation, and when the testing is over a preparation of soda should be used to all vessels in which cream is contained.

Reading Samples.

In reading samples some operators take the depth of the fat column by ocular measurement. This is attendant with considerable liability to under-estimate the fat reading, and an error of 1 per cent. amounts to a considerable weight of fat when a dairyman is supplying large quantities of cream. Especially is the danger greatest when the fat column is opaque and the water milky or otherwise discoloured.

Judging from the answers to this question in Australian Government examinations of milk and cream testers, mistakes have been of common occurrence. Using an 8.8 cream pipette, the fat should be read from the letter A in the diagram to the bottom of the meniscus B. With an 8.7 pipette the reading should be from A to the top of the meniscus D. Tests to ascertain the rate of contraction of the fat in milk and cream test

bottles, and the appearance of the meniscus showed that, as the fat column falls in the tubes, the meniscus lengthens practically in proportion to the contraction, making the liability to error in reading the sample less dangerous in the case of cream, which keeps its heat, and is therefore not so subject to the influence of a lower temperature as milk. The illustration will show the changes referred to.



Showing Meniscus in Milk Test Bottle; also in a 40 °/₀ and a 50 °/₀ Cream Test Bottle.

Abuses of the Pipette and Wash Water.

The pipette is frequently used for purposes for which it was not intended, namely, to stir cream, to break up lumps of cream, to stir milk, &c. Such liberties impair the correctness of the measure, caused by the wearing and breaking of the point, and it may be said that many glass beakers are rendered worthless by the improper use of the pipette.

WASH WATER.—When the pipette is carefully operated, clear water will be forced from the point to an inch or more up the stem, and, in the event of the wash water exceeding the 8.8 mark, it may be lowered to the proper measurement without a trace of cream being allowed to escape. In doing this, the water should not be run into the wash dish, but into a larger vessel kept for general purposes.

In the event of the operator not succeeding in retaining this clear water, and having an excess of milky water in the pipette, it is an error to reduce the measurement; the addition of a little more acid to the cream will overcome the mistake. Cream testers should finish work without the wash water in the vessel showing the slightest discoloration. Many neglect to exercise caution in this direction, and after the first use of the pipette the wash water becomes quite opaque through coming into contact with cream from the outside of the instrument, and by the running of the overplus water from the pipette into the wash vessel.

GRADUATIONS.

When the lines of graduation in the necks of milk or cream bottles become obliterated or indistinct, a brush dipped in black enamel and rubbed over the lines will bring them out very clearly.

Skim Milk Testing.

The writer desires to particularly draw the attention of students to the great desirability of giving this subject

their united attention. Fluctuations in the fat reading of cream are daily occurring, and inquiries show that little is done on the farm to investigate the efficiency of the separator. No doubt, to a large extent, the dairyman is protected against serious loss by a defective or badly manipulated separator, through his pigs and calves utilising the product as a food. Unfortunately the cream supplier has been practically prohibited from engaging in the fat testing of skim milk, through the cost of the glassware and the danger of breakages in using the delicate bottles necessary to the work. A cheap, simple, and effective bottle has now been put on the market, also pipettes specially designed for use with the bottles.

Fat Losses in Buttermilk.

The escape of fat in the churning of cream is determined by the proportion of fat left in the buttermilk. That it varies considerably is well established, and not infrequently the amount lost is a potent factor in the yield of butter. To determine the loss of fat in churning cream, every factory should test the buttermilk daily, and when found excessive active steps should be taken to ascertain the cause. Losses are chiefly attributed to the following:—

a. Over-ripened cream.
b. Under-ripened cream.
c. Mixed supplies of cream.
d. High temperature of cream.
e. Speed of churn.
f. Density of cream.

a. Over-Ripened Cream.—In the churning of an over-ripened product, the action of the high percentage of acid is to liberate the fat quickly. Even at low temperatures, this undesirable and costly change is in evidence, and it is not unlikely that much fat goes to waste during hot weather, and more especially where factories are not properly equipped with refrigerating machinery.

b. Under-Ripened Cream.—When cream is not sufficiently acid, the breaking stage is retarded, caused by the adherence of the particles of fat to the non-fatty solids, and in this condition of fat coalescence, there is not a regular and simultaneous formation of butter particles, and the escape of fat in the butter-milk is much augmented.

c. Mixed Supplies of Cream.—Here the danger is greatest, and is one more powerful factor against "pooling." When sweet and ripe quantities of cream are mixed and churned, the breaking stage of the grains is irregular, thereby depriving the butter of its proper percentage of fat. In churning mixed creams the over-ripened proportion will break first, followed by the ripened, and lastly, the sweet cream, but not sufficiently to yield its fat before the butter-maker finds it necessary to stop the churn to prevent over-churning.

d. High Temperature of Cream.—Temperature is a forceful agent in influencing the time occupied in churning, and it materially affects the water percentage of butter and of other component parts. In the cooling of the cream great care is necessary to reduce the fat and non-fatty solids to a uniform degree.

This can only be done when sufficient time is given to the chilling, as the fat retains its heat longer than the other solids, and when this is neglected, the dangers of loss of fat are increased.

e. Speed of Churn.—The speed of the churn influences the breaking of cream into fine particles of butter. Speed should be regulated according to the quantity of cream in the churn, its acidity, density, and temperature.

f. Density of Cream.—Where cream varies in density, there will be found a marked difference in acidity, even when all things governing the process of ripening are equal. Here we have two evils at work, and which act dangerously on the fat yield of creams by enriching the buttermilk with the element of most value to the farmer and factory.

Testing Buttermilk.

The use of the milk bottle for estimating the fat of this by-product of the factory is universal, but there are objections to its application on the grounds of its calibre and wide graduations. The bottle should have a finer stem of reduced length, gauge from 0° to 30°.

Testing Whey.

For the benefit of cheese-makers, the writer might point out that the same special apparatus used for the testing of separator milk can be employed in the estimation of fat in whey. In making tests, it is necessary to carefully mix the whey before taking the sample, and, to do this effectively, the drip method should be followed.

Condensed Milk.

It is generally considered that the butter-fat in sweetened condensed milk cannot be satisfactorily determined with the Babcock tester, on account of charred flocculent matter collecting under the fat column. Very satisfactory and concordant results may be obtained by pursuing the method adopted by the writer. Fifty (50) grammes of the condensed milk are weighed out and dissolved in hot water, making 200 c.c. This is cooled and after mixing the solution well, 17.6 c.c. are taken out with the ordinary milk pipette and put into the test flask; 1 c.c. of amyl alcohol is added to the milk in the flask, also from 13 to 15 c.c. of sulphuric acid of 1.785 specific gravity (85 per cent. H_2SO_4) until the mixture assumes a dark chocolate colour. The flasks are now whirled at full speed for four minutes; boiling water is added in the usual way, and the tester is set agoing for one minute; more water is added to bring the fat column up the neck of the flask, and the machine is whirled again for one minute and the fat column read in the usual way.

The amount of fat multiplied by four gives the percentage of butter-fat in the sample of condensed milk.

Testing Cheese.

The testing of cheese for butter-fat should be undertaken at every cheese factory, and were encouragement given to managers to do this, it would be a fruitful step. There is no reason why it should not be carried out regularly, and a record kept of the fat tests for

educational and commercial purposes. Such an addition to factory management would also add to the attractions of those engaged in the manufacture of cheese. Before this is done, however, tuition in the use of the chemical balance by a qualified person would be necessary, and the competency of the operator to efficiently manipulate it thoroughly assured.

Making the Test.

A sample is taken from different parts of the cheese, and carefully cut into strips thin enough to slip into a milk test bottle. Five grammes of the cheese are weighed on a delicate chemical balance, and when the sample is put in the bottle the cheese is treated with 12 c.c. of warm water. 17 c.c. of sulphuric acid of a 1.825 specific gravity strength is then added to each sample and the whole is mixed with a smart jerk first one way and then another, as explained in testing cream. Samples are then placed in the machine and whirled for four minutes, after which boiling water is added to bring the fat to the base of the neck.

Bottles are whirled for two minutes. Boiling water is again added to bring the fat into the graduated neck. Bottles are finally treated in the machine for one minute and the fat is read off. The fat in most cases is inclined to be light in colour, but is usually free from sediment.

It was noticed in tests made by the writer that the water under the fat column was clear and bright when the bottles were treated to the particular motion in the mixing of the acid with the curd.

Losses of Fat in Cheesemaking.

IMPORTANT CAUSES.—The attention of the reader is drawn to losses which are of common occurrence. Acquaintance with these will help to prevent any miscalculation in determining the fat contents of cheese from the quality of milk used in its manufacture.

It might be mentioned that cheesemaking and buttermaking will be fully dealt with in "Dairying for all Countries."

Cheeses poor in butter-fat can be attributed to many causes, viz., breed of cattle, food, mixing cold and warm milk, preservatives, watered milk, inferior rennet, uneven cutting, careless stirring of the curd, rapid development and excess of acid during cooking, cooking too rapidly and at too high a temperature, hooping at excessive temperatures, and quick and heavy pressing.

BREED OF CATTLE.—It must be admitted that certain breeds of cows are better adapted for cheesemaking than others, because of the smaller globules of fat in their milk and heavy yield. The Ayrshire fulfils the requirements of the cheesemaker exceptionally well; likewise are the Shorthorn and Holstein well suited. The Jersey is not credited with the same worth, as the fat globules are large and escape readily in the process of manufacture, thereby impoverishing the cheese of the most valuable constituent.

FOOD.—The milk of the Jersey is made more unprofitable, as succulent and immature herbage predisposes to soft fats, rendering their loss in cheesemaking greater. Dairy farmers in cheesemaking districts

will find it necessary to study this question, and by alterations in feeding their milking stock encourage the production of harder fats.

MIXING COLD AND WARM MILK.—Quantities of cream are frequently seen floating on the surface of the whey in the vat; this principally arises from mixing the evening's cold milk with the morning's supply and sending it to the factory with the cream in a clotted condition.

ACID AND FAT LOSSES.

To prove that excess of acid causes the escape of the most valuable constituent of cheese, the following figures are given from an experiment conducted by the writer :—

	Fat in Milk.	Fat in Whey from Curd after Salting.	Fat from Press.	Acid at Pressing.
	Per cent.	Per cent.	Per cent.	Per cent.
A - -	3·5	0.3	0.8	0.85
B - -	3·4	0.9	1.2	1.95
C - -	3.6	2.1	1.2	0.90
D - -	3·7	2.1	3.2	1.00

The percentage of acid at pressing is high in B, C, and D, while the fat percentages are correspondingly high in the curd before and after pressing.

It is reasonable that fat will escape when the particles of curd become speedily contracted, a condition which takes place when there is a rapid development of acid or a quick and high temperature. To avoid

these heavy losses in butter-fat, the "secret" is to have the milk as near as possible to a fixed acidity by gradual and careful cooking.

Danger of High Temperatures.

The following experiment which the writer carried out proves the evil of a high temperature upon the fat percentages in curd. Four hundred and seventy-eight gallons of milk were treated, and all practical and scientific tests applied.

The quality and purity of milk were high. After the usual care in aerating the milk by a circulation of cold water in the jacket of the vat, the temperature was raised to 88° Fahr., the cup test showing twenty seconds. The alkaline test was next applied and repeated at different stages in manufacture. Work proceeded on the usual lines, the scalding temperatures being, however, allowed to run to 104° Fahr., afterwards the curd was left to settle, when a sample of whey was taken for fat analysis.

Additional samples of whey were kept from the strainer and analysed. The time of removing the curd to the cooler was dependent on the result of scientific tests. With an advanced acid in the curd, smell and feel by hand give little or no indication of its condition, and are decidedly unreliable with rich and changeable milk. An accurate practical indication of the condition of curd is better ascertained by the grit on the teeth. Although the writer has not advocated this, he feels confident that cheesemakers, after a term of training, guided by the hot iron and alkaline

tests, can by this means measure the acidity very successfully.

Immediately after the curd was transferred to the cooler, thorough stirring was conducted for five minutes; afterwards the curd was allowed to mat for a further period of twenty minutes, and then cut. The square blocks were arranged in rows of two deep, and milling followed immediately the desired acidity was reached. The curd was now salted at the rate of 2 per cent The second cheese was made on the same lines, but cutting was not done so fine, and the scalding temperature was only raised to 99° Fahr. The object of this was to compare the losses of butter-fat in the whey.

ABSTRACTS FROM RECORDS OF MANUFACTURE.

No.	Seconds Test.	Temperature of Milk at Time of Renneting.	Time of Coagulation.	Temperature heated to	Time of Heating.	Time Settled in Whey.
		Fahr.	Mins.	Fahr.	Mins	Mins.
1	19	86°	30	104°	40	15
2	20	86°	35	99°	45	25

ACIDITY TESTS.—Milk before renneting, 0.19 and 0.20; whey before breaking, 0.15 and 0.14; whey when drawn, 0.16 and 0.18; curd whey when taken to cooler, 0.20 and 0.28; liquid from press, 0.7 and 0.5 per cent. of acid.

PERCENTAGE OF FAT IN WHEY.

	Before Running off.	From Strainer.	From Press.
	Per cent.	Per cent.	Per cent
No. 1 Cheese - -	0.30	0.35	0.50
No. 2 Cheese - -	0.25	0.25	0.35

The excess of fat in No. 1 is owing to finely cut curd exposed to the influence of high and rapid scalding.

Some Errors in Cream Testing.

The writer has conducted an investigation into the following subjects :—

Taking the sample.
Cup-dipper *versus* syringe.
Cans and mixing the cream.
Influence of temperature.
Influence of preservatives.
Sulphuric acid and its action.
Effects of watered cream.
Influence of graduated bottles on the fat column.
Badly washed bottles and the fat percentage.
Evil effects of gases in cream.
Manipulation.
Causes of cloudiness of water beneath the fat column.
Evaporation of water and fat percentage.

Clotted cream and the fat reading.
Weight *versus* measure.
Cause of discoloration of fat.
Salt in cream.
Faulty glassware.

The following are extracts from the investigations, some of which have not been dealt with in the preceding pages.

HEATING SAMPLES OF CREAM AT DIFFERENT TEMPERATURES.—It was shown that slightly overheating cream in winter weather will cause a reduction of as much as 1 per cent. of fat in the test.

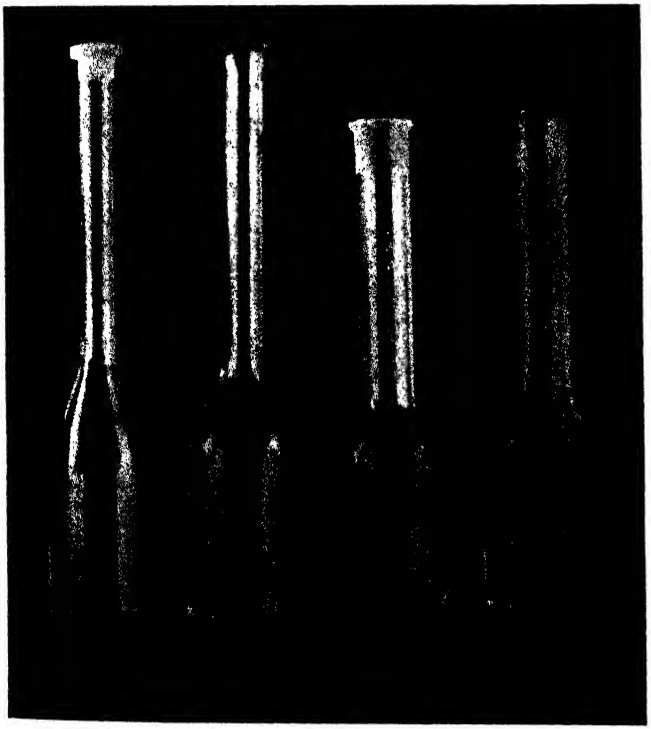
ACID AND THE ATMOSPHERE.—The exposure to the atmosphere of sulphuric acid of a fixed strength, contained in different shaped vessels, and left uncorked for a night, gave the following specific gravity tests :— 1.826; 1.824; 1.804; 1.800.

ACID AND THE FAT READING.—Very extensive experiments were made with acids, and the results were in favour of 11, 12, or 13 c.c. for a cream test. Measures graduated from 11 c.c. to 18 c.c. are recommended for use in whole milk, skim milk, cream, and whey testing.

WATERED CREAM.—To show how important it is to mix cream thoroughly, and how readily the thin or watery substances may separate from the solid matter, a quantity of cream was diluted with water, and persistently stirred and poured from one vessel to another until it appeared to be thoroughly mixed. The cream was immediately afterwards tested at the

top, middle, and bottom of the vessel, and each test recorded 22 per cent. fat. At the end of seventy-five minutes the fat read 23, 19, and 75 per cent. respectively.

INFLUENCE OF CREAM BOTTLES ON THE FAT PERCENTAGE.—Bottles graduated to 25, 30, 40, and 50 per cent. were tested 144 times. The 25 and 30 per



25 30 40 50

Cream Bottles graduated from 25 to 50 per cent. Forty and fifty per cent. Bottles have been shown to give inaccurate Measurements of Fat.

cent. bottles gave the same reading, while the others showed an increase of 2 per cent. of fat. The cause of this increase was found in the greater circumference of fat forcing itself up the neck of the bottle, leaving a hollow which was not noticeable to the tester. (See illustration.) Such irregularities as these were no doubt responsible for differences in the churning results, compared with the fat tests.

The finding of the above defect caused the writer to suggest a standard bottle graduated to 30 per cent.

BADLY WASHED BOTTLES.—Four cream bottles were carefully washed after use, and four were carelessly treated. The eight bottles were used with the following results :—

Badly Cleaned Bottles.	Cleaned Bottles.
47.00 per cent.	46.5 per cent.
46.75 ,,	48.5 ,,
46.50 ,,	46.5 ,,
47.00 ,,	46.5 ,,

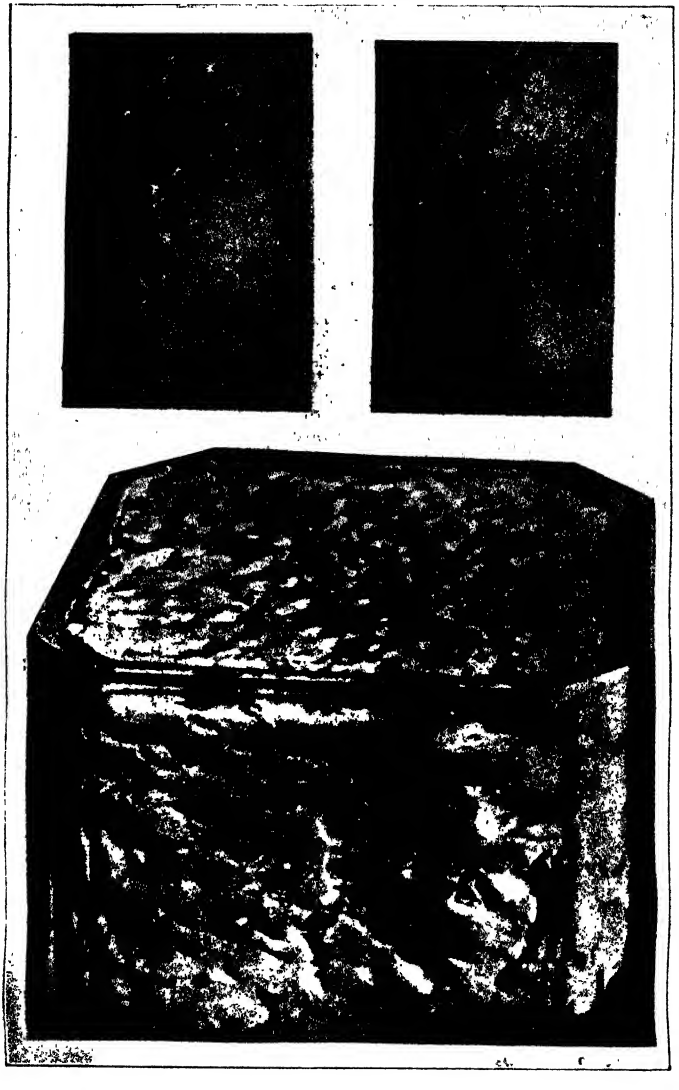
INFLUENCE OF LIGHT ON MILK AND CREAM SAMPLES.—In the bacteriological section of milk and cream testing, the writer has found that the exposure of milk and cream to light influences the fat percentage. This is greatest when the light is accompanied with heat, particularly a moist atmosphere. In investigations with gassy milk and cream it was noted that samples which were kept in darkness, compared with duplicate samples which were kept in light, showed lower percentages of lactic acid. Bacteriological changes,

no doubt, are responsible for the slight variations that follow exposure to light.

GASES IN CREAM.—Samples of fresh and ripe cream were tested in the usual way, care being taken to thoroughly mix the cream in the first instance by pouring from one vessel to another. In the second test they were shaken vigorously, as is customary in

Tube inoculations showing bells of gas produced by organisms.

factories and depots. The cream that was mixed in the ordinary way tested fresh 35 per cent., ripe 35 per cent. When shaken vigorously and immediately sampled by the pipette, the fresh gave 33 per cent. of fat and the ripe 32 and 31 per cent. respectively. It also was found that fermented cream gave very misleading results owing to the higher proportion of gas in the cream.



Samples of Milk inoculated with the Gas-producing Organisms.

Cheese Curd from inoculated Milk, showing spongy condition. Cheesemakers have had experience of floating and pinhole Curds. The above Illustration shows the action of the germ.

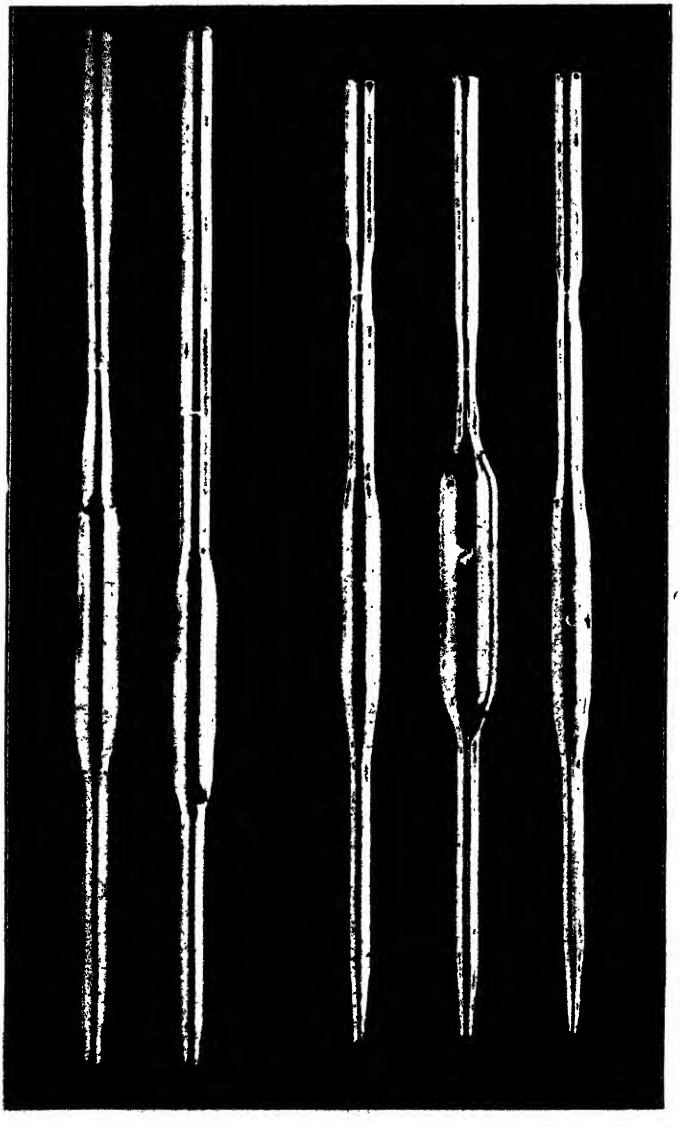
IMPORTANCE OF MIXING THE ACID. — From extensive researches in testing and close observation in practice, the writer has demonstrated that the usual way of mixing acid with the cream may be productive of error, as the acid will not incorporate with the cream and brown it instantaneously. A half circular motion should be given, the bottle being brought to a very abrupt stop and at once returned in the same quick muscular manner. When this is done the whole body of cream will brown at once, the colour of the fat will be satisfactory and the water under the fat column will not be opaque or show a cloudy appearance.

TEMPERATURE OF TEST WATER.—The temperature of the water used to wash out the cream pipette and dilute the cream in the test bottle should be higher than is generally used. In the winter weather of Australia it was found advantageous to raise the temperature of the water to as high as 200 Fahr., and to add to the bottles when in the machine, water of a temperature not under 200° Fahr. Practical experience is in this case, as in others, most invaluable.

EVAPORATION OF WATER IN CREAM CAUSING A HIGH FAT TEST.—A test was made which resulted as follows:—

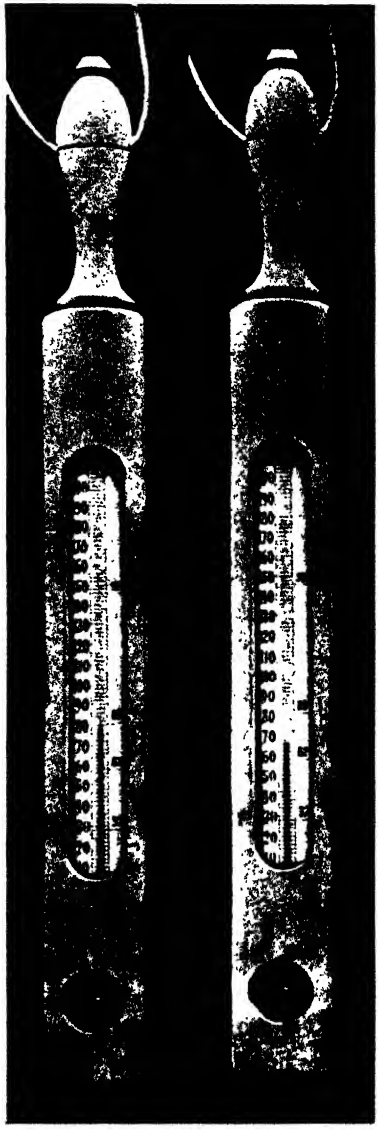
Samples of Cream exposed to the Atmosphere.		Samples similar in Quantity from same Supply, but protected from Atmosphere.
Exposure.	Fat Test.	Fat Test.
	Per cent.	Per cent.
2 hours	30	30
4 „	29	30
6 „	26	30
8 „	26	30
10 „	25	30

DEFECTIVE PIPETTES.—When these investigations were started by the writer, different sized pipettes were in use in Australia, ranging in capacity from 7.5 to 9 c.c. The design of some of the pipettes caused a reduction in the fat percentage of cream, as the outlet was so wide that a proportion of the cream readily escaped before it passed into the cream bottles. These discrepancies have now been remedied, and the pipette which was designed by the writer about four years ago is giving entire satisfaction throughout the Commonwealth. It is constricted at the fat line to ensure an accurate proportion of cream. The pipette has an elongated "bulb" and the point is tapered, the opening being thirty-seconds of an inch in diameter.



Improved Pipettes with constricted necks and tapered outlets.

Inferior Pipettes showing short stem and wide outlets.



CHEAP DAIRY THERMOMETERS.
14° too high. Correct.
All Thermometers should be tested before use.

INFERIOR THERMOMETERS AND GLASSWARE.—The use of accurate thermometers in the testing of milk and cream is absolutely necessary. Many instruments at present in use are incorrect, and the following will show the error of purchasing cheap thermometers :—

THIRTY FLOATING DAIRY THERMOMETERS PURCHASED IN ONE LOT.

Tested at 100° Fahr.	Tested at 76° Fahr.
3 correct	1 correct
6 − 1°	6 − 1°
12 − 2°	14 − 2°
3 − 3	6 − 3°
3 − 4	1 + 2°
1 + 2°	1 + 1°
1 + 1°	1 + 14°
1 + 14°	

− Degrees below the correct temperature.
+ Degrees above the correct temperature.

Dairy glassware should be standardised by Government, as no other means will ensure accuracy in graduations, and general efficiency. The writer's experience abroad justifies this conclusion.

THERMOMETER CHARTS.

For the practical guidance of farmers and factory hands, particularly in warm countries, the following charts have been arranged by the writer :—

For Dairy Farmers.

Fahr. Degrees.		
32.	Freezing.	Cream.
35.	Well preserved.	
40.	Preserved.	
45.	Very sweet.	
50.	Sweet.	
55.	Very fine flavour.	
60.	Fine flavour.	
65.	Very good flavour.	
70.	Good flavour changing.	
75.	Flavour sour.	
80.	Tallowy and oily.	
85.	Very inferior.	
85.	Separating, summer.	
90.	,, winter.	
90.	Calves' milk, summer.	
95.	,, ,, winter.	
140.	Scalding pigs, summer.	
145.	,, ,, winter.	
185.	Scalding milk for household purposes.	
212.	Scalding temperature for washing utensils.	

For Buttermakers.

-5.	Temperature export butter should be carried at.
15-20.	Storage temperature of butter before shipment.
43-48.	Temperature of water for washing butter for summer months.
50-53.	Temperature of cream for churning in summer.
50-58.	Grading temperature of butter.
53-58.	Temperature of water for washing butter in winter.
53-58.	Temperature of cream for churning in winter.
70.	Ripening starter.

FOR CHEESEMAKERS.

Fahr. Degrees.	
48-54.	Curing temperature, summer.
54-60.	Curing temperature, winter.
70.	Ripening starter.
75-80.	Hooping temperature, summer.
80.	Hooping temperature, winter.
82.	Renneting fast milk.
84.	Renneting ripe milk, summer.
86.	Renneting ripe milk, winter.
90.	Temperature of curd in cooler summer.
93.	Temperature of curd in cooler winter.
98-100.	Scalding normal curd.
102-104.	Scalding fast curd.

FOR CREAM TESTERS.

70.	Temperature of cream, summer.
75.	Temperature of cream, winter.
90-95.	Temperature of wash water in summer.
95-100.	Temperature of wash water in winter.
100.	Wash water for inside of pipette, summer.
110.	Wash water for inside of pipette, winter.
185-195.	Temperature of water added to bottles.
190.	Temperature of tester.

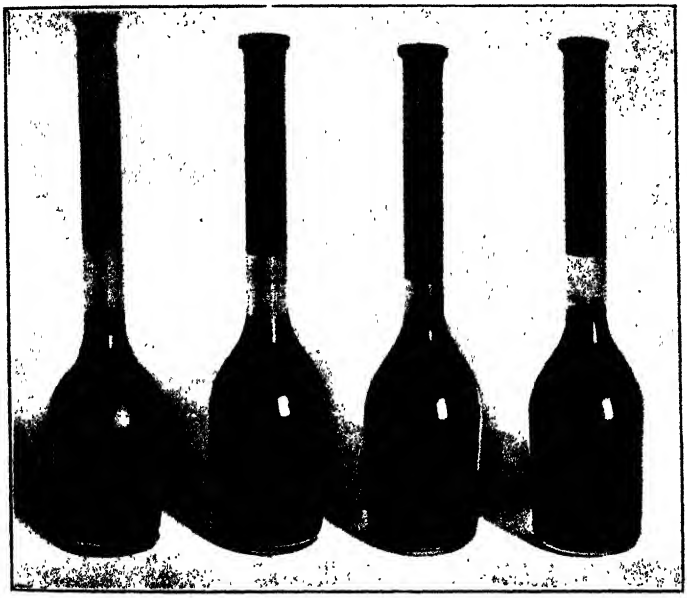
FOR CREAM SUPPLIES.—A thermometer is indispensable to suppliers of cream who are situated at inconvenient distances from railway stations and cream depots. By the use of the thermometer and the chart experience will be gained which will help to show in which direction reforms should be made to maintain a sweet cream supply.

CREAM PRESERVING.

The following test was carried out to illustrate the properties of different preservatives :—

Sample No.	Preservative.	Acidity after 7 Days.	Condition of Cream.
	Cream Initial Acidity = .058 per cent. Lactic Acid.		
		Per cent.	
1	*Nil* - - - -	.520	Very thick.
2	2 drops formalin per 3 oz.	.128	Fluid.
3	5 „ „ „	.128	„
4	.25 gr. boric acid per 85 gr.	.532	Very thick.
5	.50 gr. „ „	.252	Fairly fluid.
6	.1 gr. bichromate per 85 gr.	.152	Fluid.
7	.25 gr. „ „	.236	„
8	.50 gr. „ „	.360	„
	Composite Samples—Initial Acidity (1) .058 per cent.; (2) .064 per cent.; (3) .060 per cent.		
1	*Nil* - - - -	.564	Very thick.
2	.1 gr. bichromate per 3 oz.	.120	Fluid.
3	.25 gr. „ „	.152	„
	Fat Percentage—Fresh Cream, 50.6 per cent. Fat.		
			Average.
1	*Nil* - - - -	50.0, 50.6	50.3
2	2 dr. formalin - - -	50.6, 49.8	50.2
3	5 dr. „ - - -	49.8, 49.8	49.8
4	.25 gr. boric acid - -	51.0, 50.0	50.5
5	.5 gr. „ - -	49.4, 49.6	49.5
6	.1 gr. bichromate - -	50.0, 49.8	49.9
7	.25 gr. „ - -	50.2, 49.8	50.0
8	.50 gr. „ - -	50.4, 49.6	50.0
	Composite Sample— Fat (1) 50.6; (2) 44.0; (3) 45.8; Average, 46.8.		
1	*Nil* - - - -	46.8, 47.2	47.0
2	.1 gr. bichromate - -	48.2, 47.2	47.7
3	.25 gr. „ - -	47.4, 47.4	47.4

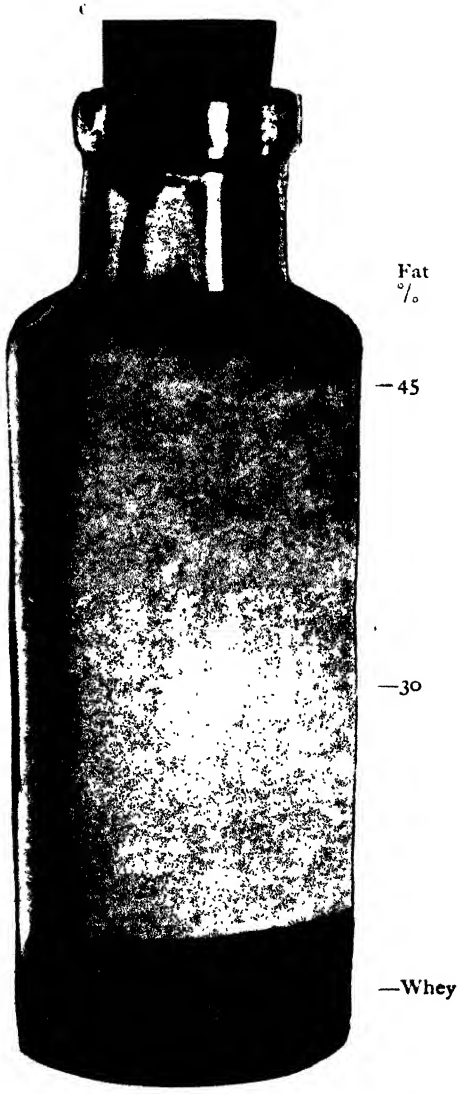
For determination of fat the cream was measured with a pipette. Throughout the test it could not be observed that any of the preservatives used had any effect upon the fat column. Bichromate and formalin kept the cream sweet and fluid for seven days.



Dark colour caused by adding salt to cream. When the salt is in large quantities a heavy deposit is found at the bottom of the fat column, also at the junction of the water and dark contents of the test bottle.

Formalin preserved the cream better in one series of experiments, because the cream was absolutely fresh for a start.

As the result of these and other tests, the writer would recommend bichromate of potash for the exclusive



Sample taken from can of cream which contained salt. It was allowed to stand for two days, when it was examined for fat. Note the percentages.

use of preservating cream samples for butter-fat testing. It is well to remind factory employees of the marked poisonous properties of this chemical.

Salt as a Preservative.

In the analyses of samples of cream for butter-fat, defective fat reading was noticeable in some instances, the colour of the fat column being distinctly black. In treating a number of samples, the action of the sulphuric acid was sufficiently violent to cause the contents of the test bottles to fly out in a dangerous manner. The smell of the mixture gave an indication that a foreign body had been added to the cream, and suspicion was aroused that common salt was responsible for the active chemical change and the discoloured fat reading. Tests to determine the action of salt in this direction were made as follows:—A solution of salt was prepared and measured into duplicate quantities of 2, 4, 5, and 6 cubic centimetres. A large beaker of cream was divided into twelve equal proportions, and those were numbered A and A_1, B and B_1, C and C_1, D and D_1, E and E_1; 2 c.c. of the solution were added to B and B_1, 4 to C and C_1, 5 to D and D_1, and 6 to E and E_1. The butter-fat reading and the colour of the column were as follows:—

		Fat, per cent.	Colour.
Control	A	49	Slightly grey.
	A_1	49	„
2 c.c.	B	48	Dark brown.
	B_1	48	Grey.
4 c.c.	C	46	Dark brown.
	C_1	46	„

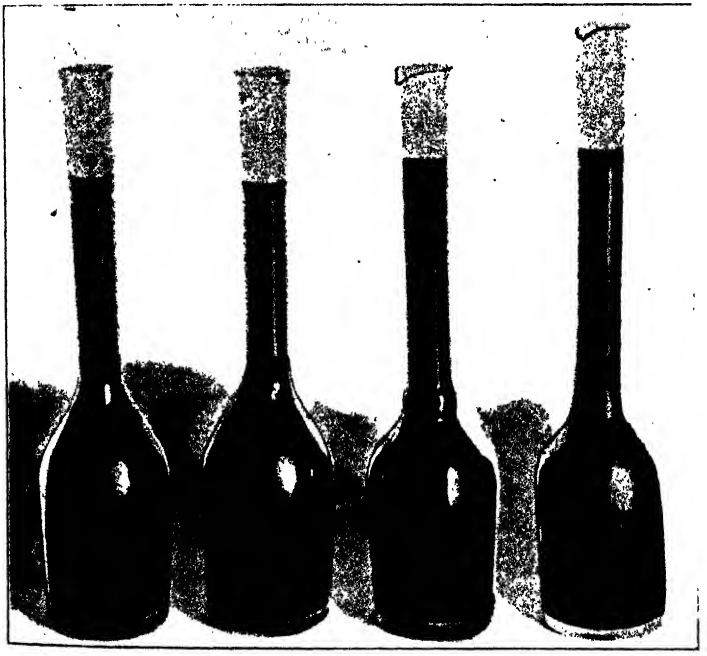
	Fat, per cent.	Colour.
5 c.c. - D	45	- Dark brown.
5 c.c. - D_1	45·5	- „
6 c.c. - E	39·5	- Very dark with black deposit.
6 c.c. - E_1	40.0	- „ heavy black deposit.

Further experiments confirmed the action of salt on the colour of the fat.

Experiments to Remove a Dark Colour from Fat.

No matter how careful samples are taken, the fat columns in the test bottles will not be regular in colour, unless the acid is of the proper strength and the cream of suitable quality. Many theories have been advanced as to the cause of the opaque appearance, and how it may be prevented and corrected, but success has not generally followed the applications of many so-called remedies. A large number of tests were conducted by the writer; ammonia, ether, and other chemicals being used to purify the fat. The action of ether on the fat was, in many instances, noticeable in improving the colour; also chilling the fat and reheating were distinctly beneficial. Standing the flasks in boiling water for fifteen minutes before putting into the machine was likewise an improvement. But the practices which gave the best result could not be termed practicable in the average factory, where many samples have to be dealt with from day to day. Experiments were then made with a view to ascertaining the action of the acid on the solids in the cream when added in different ways. The results of the first series of tests are given in the following order:—

		Fat, per cent.	Colour of Fat.
Bottles chilled after addition of acid to cream; thence heated.	A	50	Dark.
	B	50	Slightly dark.
	C	50	Dark.
	D	50	Slightly dark.
	E	50	Clear.
	F	50	,,
	G	50	,,
	H	48.50	,,



1 2 3 4

Nos. 1 and 2 were originally very dark in the fat. After exposure to a high temperature for ten minutes, followed by rapid whirling, the dark colour was forced to the base of the fat column. Nos. 3 and 4 were treated with ether, alcohol, and other chemicals without any good results.

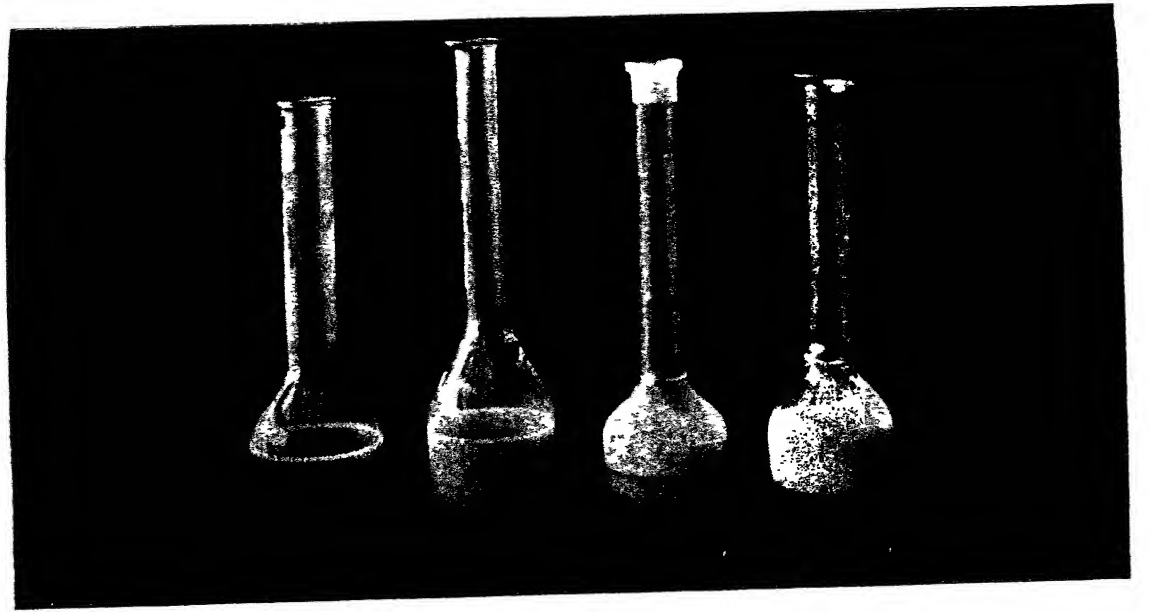
After cooling samples A, B, C, and D in a temperature of 50° Fahr. for one hour, and treating in the tester in the ordinary way after a thorough heating, the dark colour disappeared from the fat, forming a black deposit at the base of the column.

		Fat, per cent.	Colour.
Chilled fat afterwards heated and whirled.	A	49	Very clear.
	B	49	,,
	C	48	,,
	D	47.6	,,

ADDING ACID DOWN THE SIDE AND CENTRE OF BOTTLES.

		Fat, per cent.	Colour.
Acid down side, and shaken in a rotary motion.	A	50	Brown.
	B	49	,,
	C	50	,,
	D	50	,,
	E	49	,,
	F	49	,,
	G	50	,,
	H	50	,,
Acid down centre, and shaken in a rotary motion.	I	49	Perfect.
	J	49	,,
	K	49	,,
	L	48.50	,,
	M	49	Clear.
	N	48.50	,,
	O	49	,,
	P	49	,,

Pouring the acid down the centre of the test bottles has been shown to give a brighter reading than when poured down the side, but the former practice is more



ADDING THE AC[ID] TO CREAM.

Dark colour shows careless delivery of acid.

More care has been shown in adding the acid.

[C]olour indicat[es] [f]urther care.

Showing perfect delivery of acid.

liable to cause a black deposit at the foot of the fat column.

Chilling the Acid.

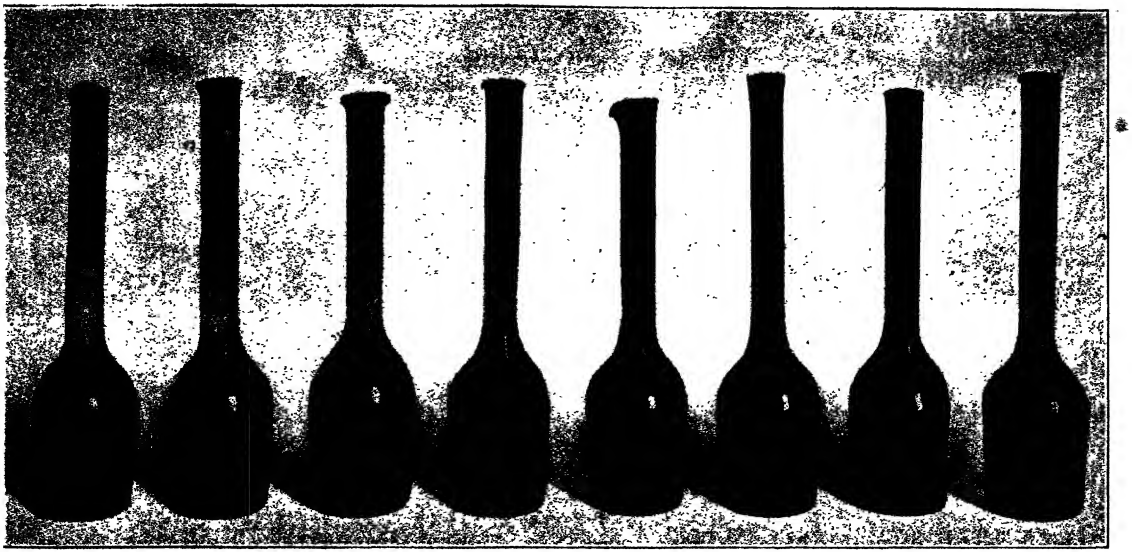
Chilling quantities of acid before testing proved to give good results. The fat in all cases when treated with the cold acid showed a brightness. This led to further tests with sulphuric acid, and which proved to be most valuable in the accurate testing of milk and cream. Sulphuric acid of 1.823 strength was used up to this stage of the experiments, when diluted acid and smaller quantities were tried, and the results compared with samples treated with the "normal" acid. This was confirmed by subsequent tests, and the conclusion arrived at was, that more attention will have to be given to this factor by those engaged in the testing of milk and cream.

The following is taken as an average of the tests :—

Quantity of Acid. Strength, 1.823.	Fat, per cent.	Colour.
12 c.c. - - -	32 - -	Perfect.
15 c.c. - - -	32 - -	Bright amber.
20 c.c. sulphuric acid -	32 - -	Dark brown.
25 c.c. „ „ -	31 - -	Dark brown and slate colour.
17.5 c.c. „ „ -	31 - -	Brown.
1 c.c. of water added to 17.5 c.c. of acid -	32 - -	Amber.
2 c.c. of water added to 17.5 c.c. of acid -	32 - -	Light pale.

Tests were made of sweet, acid, and stale cream, and it was observed that the ripe product gave a more regular colour than the other samples.

Colour	Perfect	Am		ırk Brown	Brown.	Amber.	Light Pale.
Fat				Slate Colo			
Acid			0 c.	25 c.c.	Normal	:.c. water	2 c.c. water
					823.	ıdded to	added to
						5 c.c. acid.	7.5 c.c. acid.



Colour of Fat	Perfect.	Perfect.	Perfect.	Perfect.	Dark.	Dark.	Dark.	Dark.
Condition of Acid	Chilled.	Chilled.	Chilled.	Chilled.	Normal acid.	Normal acid.	Normal acid.	Normal acid.

When the acid does not cause an irregular deposit of black or charred matter at the base of the fat column, the fat reading is not subject to error. A milky colour is far more dangerous, as it adds to the reading.

SHOWING GRANULATED FATS AFTER CHILLING.

Influence of Temperatures.

The action of heat or cold on samples of milk or cream influences the quantities taken. Evidence of this will be obtained from the following experiment with cream. Samples were brought to the following temperatures before adding the acid, viz., 40° Fahr., 60° Fahr., and 70° Fahr.

		Fat, per cent.	Colour.
40° Fahr.	A	50.5	Brown.
	A_1	50.5	Clear.
60° Fahr.	B	50	,,
	B_1	50	,,
70° Fahr.	C	50	Light.
	C_1	50	Light brown.

Temperature of Tester.

In testing a quantity of cream the temperature of the bottles was raised from 170° Fahr. to 208° Fahr., and an increase of 1 per cent. of fat was given. In using the Russian and turbine testers, operators should very carefully guard against error in this direction.

Water used in Testing.

The quality of the water used in testing milk and cream calls for some consideration, although recent investigations have not thrown much light on the subject. Water containing lime, sodium, and magnesium compounds were used, also cold and boiled rain water, and cold and distilled water. The percentage of fat was practically the same throughout all

the tests, although the colour of the fat varied from yellow to dark brown.

Indications of a Proper Test.

In the large number of tests made it was observed that the clearness of the water beneath the fat column, the absence of any discoloration from the fat, and the fine, pale amber colour, with a distinct circle at the base and an even and regular meniscus, were reliable evidence that the acid was at the proper strength, and the separation of the fat thorough.

Those who are acquainted with the cream supply of oversea countries will know that serious errors are made by farmers in the working of the separator, and in the condition of cream at the time of testing. All through the foregoing experiments the most satisfactory results have been obtained from cream containing about 35 per cent. fat, and the writer would strongly recommend that the aim of the farmer should be to separate cream of the above consistency. Let readers carefully peruse these pages, and note that the evidence in support of this conclusion is sufficient to warrant what has been said. It is also suggested that farmers who are compelled, through distance and other adverse conditions, to keep cream for a number of hours at the farm should pursue the practice of carefully stirring it, so that the body of cream will not have time to settle into adhesive layers. The four-flanged plunger designed by the writer and illustrated here has been shown to suit the purpose aimed at, and to be much superior to the stirrers at present in use.

PERFECT SEPARATION OF FAT.

Measure *v.* Weight.

The practice of measuring samples of cream for butter-fat testing is universally followed in some countries. It has much to commend it, being expeditious and thoroughly reliable when entrusted to responsible persons.

The author had a series of comparisons made between measured and weighed quantities of cream, and the differences in the fat percentages led to considerable changes in the taking of samples and in the appliances used and methods followed in the testing of milk and cream. Readers are asked to give special attention to the measurement of fat in the test bottles and to all instructions which govern accurate testing.

Comparing the Measure and Balance.

Taken from within 12 inches of surface of a can of cream.

	Fat.	Fat.	Average Fat.	
	Per cent.	Per cent.	Per cent.	
Measure - -	44.80	42.00	43.40	Unstirred.
Weight - -	53.48	53.40	53.44	
Measure - -	31.40	32.40	31.90	Well stirred
Weight - -	32.26	32.40	32.23	
From Centre of Can.				
Measure - -	30.00	31.00	30.05	Unstirred.
Weight - -	30.02	30.10	30.06	
Measure - -	31.20	32.00	31.60	Stirred.
Weight - -	29.72	29.84	29.78	

FROM BOTTOM OF CAN.

	Fat.	Fat.	Average Fat.	
	Per cent.	Per cent.	Per cent.	
Measure - -	8.00	7.60	7.80	Unstirred.
Weight - -	6.88	6.90	6.89	
Measure - -	31.40	31.40	31.40	Well stirred.
Weight - -	29.78	29.84	29.81	

FROM SWEET-ACID CREAM, 12 INCHES FROM SURFACE.

Measure - -	29.20	30.20	29.70	Unstirred.
Weight - -	29.90	30.16	30.03	
Measure - -	30.80	31.00	30.90	Well stirred.
Weight - -	31.48	31.50	31.49	

FROM CENTRE OF CAN.

Measure - -	31.40	32.60	32.00	Unstirred.
Weight - -	31.10	31.04	31.07	
Measure - -	31.00	30.40	30.70	Well stirred.
Weight - -	31.04	31.56	31.60	

FROM BOTTOM OF CAN.

Measure - -	22.40	20.40	21.40	Unstirred.
Weight - -	21.26	21.24	21.25	
Measure - -	26.60	25.20	25.90	Well stirred.
Weight - -	24.34	24.64	24.49	

SWEET CREAM. SAMPLE, 12 INCHES FROM TOP.

Measure - -	34.00	36.00	35.00	Unstirred.
Weight - -	34.36	35.00	34.68	
Measure - -	36.20	36.40	36.30	Well stirred.
Weight - -	35.68	35.30	35.49	

FROM CENTRE OF CAN.

	Fat.	Fat.	Average Fat.	
	Per cent.	Per cent.	Per cent.	
Measure - -	36.00	37.00	36.50	Unstirred.
Weight - -	34.76	35.00	34.88	
Measure - -	36.20	36.00	36.00	Well stirred.
Weight - -	35.62	35.70	35.66	
FROM BOTTOM OF CAN.				
Measure - -	36.00	36.00	36.00	Unstirred.
Weight - -	33.84	33.32	33.58	
Measure - -	35.40	35.40	35.40	Well stirred.
Weight - -	34.90	35.20	35.05	

In the aged and acid-sweet supplies of unstirred cream both the weight and measurement show a higher percentage of fat in favour of the syringe. It will be noticeable that the fat reading is more uneven in the aged cream than the acid-sweet, and in the sweet cream the figures are very regular. This is a point of considerable moment, as it is further evidence that errors in testing sound cream of a 35 per cent. density are not likely to be serious if the necessary care is exercised preparatory to taking the sample.

In the well-stirred cream from the same supplies there is still a distinct unevenness in the fat content of the samples from the aged cream. Looking through the fat percentages in the eight rows of figures should give sufficient proof of the necessity to discard old practices in the testing of cream in place of the accurate methods of the present day.

TESTING: CUT-DIPPER *v.* SYRINGE.

UNSTIRRED CREAM FROM CENTRE OF CAN.

		Aged Cream.			Acid-Sweet Cream.			Sweet Cream.		
		Fat.	Fat.	Average Fat.	Fat.	Fat.	Average Fat.	Fat.	Fat.	Average Fat.
		Per cent.	Per cent.	Per cent	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Cup	Measure	34.00	34.00	34.00	29.40	28.40	28.90	36.40	36.40	36.90
	Weight	33.30	33.32	33.31	31.08	30.80	30.94	...	35.22	35.22
Syringe	Measure	34.00	35.40	34.70	32.80	33.00	32.90	36.40	36.00	36.20
	Weight	35.92	35.54	35.73	31.46	32.10	31.78	36.16	35.64	35.90
WELL-STIRRED CREAM FROM SAME CAN.										
Cup	Measure	34.20	30.00	33.60	31.00	29.20	30.10	32.00	34.50	33.25
	Weight	34.14	34.34	34.24	31.32	31.44	31.23	35.36	35.00	35.18
Syringe	Measure	30.40	31.00	30.70	28.00	29.20	28.60	35.50	33.00	34.25
	Weight	29.96	29 80	29.88	31.18	31.32	31.25	35.90	35.58	35.74

Testing Milk by the Dr Gerber Test.

"Acid" Method.

Measure 10 c.c. of acid by means of the pipette. Be careful that the point is well immersed in the acid; suck it up slowly until it nearly reaches the bulb, then removing the upper end from the mouth, place the finger upon it, and by taking the finger off for a moment, allow the acid to run out until it comes exactly to the line on the pipette which is the correct measure.

Allow the acid to run out into the test tube in such a manner that the neck of the latter does not get wet.

For unskilful operators, or where many tests are made, the "Tilt" automatic acid measure is safe and quick. It is simply managed, and measures the exact quantity required.

Now pipette 11 c.c. of milk in the same manner, being careful to thoroughly mix the milk up first, allow this to run on to the top of the acid gently, holding the point of the pipette against the side of the test tube so as to avoid mixing the acid with the milk; lastly, add 1 c.c. of the alcohol in the same manner on the top of the milk: put a dry indiarubber stopper in firmly and shake the tube. This will cause the acid to decompose the milk, will set up a good deal of heat, and turn it a brown colour. It is therefore advisable to hold the tube with a cloth. Be careful to keep the stopper turned away from the operator or any other person, because it may be blown out, though this is very seldom the case, if care is taken to keep the stopper and the neck of the tube quite dry. Having shaken the tube well and

inverted it three times so as to thoroughly mix the contents, place it for a short time in the water bath, the water being at a temperature of from 140° to 170°; it may stay there a few minutes, not longer than a quarter of an hour, while other samples are being prepared.

Centrifuging.—The centrifugal apparatus is made in several patterns, worked by hand, turbine, or electricity. In all cases the process is simple and brief. First see that it is fixed level, and securely fastened to a table or bench. Oil the bearings occasionally. The cover is removed from the centrifugal apparatus by unscrewing the brass nut at the top.

The test tubes are placed in the brass cases on the disc with the rubber stoppers towards the circumference. If the full number be not required, place tubes opposite each other to balance the disc. The lid is screwed on, and the apparatus rotated for two or three minutes at the rate of 800 to 1,000 revolutions of the disc per minute.

Those centrifuges fitted with rotary handles are the best, as the speed is more evenly maintained. The "Simplex" pattern is actuated by winding the cord upon the spindle and then pulling it right out. Pulling the cord off once with a strong quick pull will give sufficient rotation.

READING THE RESULTS.

After rotating, the tubes should be placed for a few minutes in the water bath to keep them warm. Immediately on taking them out, read off the results quickly

before they become cool. Take the tube in the hand with the stopper downwards, and hold it on a level with the eyes in front of a window. Press the stopper in until the deepest point of the curve at one end of the fat column corresponds with one of the long marks upon the scale; then count the graduations from one end of the fat column to the other. The lowest point of the curve is the correct place to start from for whole milk, the middle of the curve for separated or skim milk. Each of the long marks denotes 1 per cent., and the short marks one-tenth of 1 per cent., thus, if the fat column takes up 35 of the short marks the percentage of fat would be 3.5.

WASHING.

To wash the tubes, empty them at once while they are warm, and then put them in an earthenware or enamelled iron vessel with hot soda water, clean them well with a brush, rinse in pure water, and hang up in the frame to dry. Wash the pipettes in soda water also. Let the indiarubber stoppers soak in the soda water for some time, or the acid will crack them.

"SAL" METHOD.

Filling the Tubes.—By means of pipettes or automatic measures fill the test bottles in the following order:—

First,	11 c.c. of "Sal" solution,	All about 60°.
Then	6 c.c. of "Butyl,"	
Lastly,	10 c.c. of "Milk."	

Insert a dry indiarubber stopper just far enough to raise

(*Continued on page* 129.)

THE PROCESS OF BOTH METHODS ILLUSTRATED.

Fill the pipette by sucking the acid into it. Stop as soon as the acid is above the line. It is both unpleasant and dangerous to draw the acid into the mouth.

Empty the pipette (chemicals and milk) into the test tube without wetting the neck of the latter.

Shake the test tube thoroughly, holding the cork in with the thumb.

Invert the test tube until all its contents are at the lower end. Repeat this three times.

Insert the test tubes in the brass holders, screw on the cover, and rotate for three minutes at 800 to 1,000 revolutions.

When reading the result adjust the fat column, by pressure on the rubber stopper, so that its lower end coincides with a long line on the scale.

The above description of the Gerber tests was supplied by the British agents.

the liquid about one-third of the graduated scale. Then shake the tube and thoroughly agitate the contents by often holding the tube with the stopper uppermost and allowing the liquid to entirely fill the graduated tube. Leave the tubes for three minutes in the water bath at about 120°.

Examinations in Milk and Cream Testing.

SOME PAPERS SET BY THE WRITER IN HIS LATE CAPACITY AS DAIRY EXPERT TO THE QUEENSLAND GOVERNMENT.

Time allowed—Two hours.

1. *Taking the Sample.*—In taking a sample of milk or cream, what precautions are necessary to prevent error in the butter-fat reading? What dipper or sample measure do you prefer to use? Give reasons for your answer. What conditions of weather, thickness of cream, and carriage of cream make the testing more liable to error, and will the percentage of acid cont[illegible] in the milk or cream call for consideration?

2. *Measures and Bottles.*—Would you use the same size of pipette or measure in testing cream as you would in testing milk? Give reasons for your answer. Are you accustomed to testing the graduations in milk or cream bottles? If so, state the method you adopt.

3. *Preservatives.*—To extend the keeping properties of milk or cream for fat testing, what preservative would you use, and in what quantity?

4. *Temperature.*—What influence has temperature on milk and cream, and how does it affect the samples for testing? Explain the action of temperature on the fat

while the bottles are in motion in the tester, and what care should be taken to produce accurate results. Why is it necessary to read the fat percentage immediately the bottles are removed from the tester?

5. *Reading the Fat Column.*—Indicate by the letters in the accompanying diagrams Nos. 1 and 2 how you would read the fat column.

Describe the proper colour of a fat column, and what indications would guide you that a test had been carefully made.

If the fat column was found to show a dark coloration or a black deposit, how would you treat the cause in the factory?

Time allowed—Two and a half hours.

1. In testing cream, state fully the influence of the 35 fat standard, basing your answer on the following:—(*a*) Separating, (*b*) collecting, (*c*) mixing, (*d*) sampling, (*e*) measuring with pipette and general treatment.

2. In testing thick cream in cold weather what precautions would you adopt to ensure accurate results?

3. What is the meaning of a high density cream? What size and description of milk and cream pipettes do you use or recommend? Give reasons for your answer.

4. Would you advise the use of cream test bottles graduated from 0 to 40 or 0 to 30, the former having a wide neck and the latter a narrow neck? Explain your answer. Describe a milk test bottle, and how would you take a sample of milk for testing?

5. Explain why the Babcock tester may be preferred

to other machines for cream testing. In answering, consider the glassware, machine, reading the sample, &c.

Time allowed—Two hours.

1. What precautions are necessary to obtain a thorough mixing of the fat in cream from the time the cream is received until the acid is added in the testing-room? Explain your answer very minutely.

What design of cream can do you recommend? Give reasons for your answer.

2. Explain the action of high and low temperatures on the solids of milk and cream, and in what way does temperature affect the proportion of fat in the test?

What instructions would you give to a farmer to separate milk and treat the cream supply, in order to lessen the difficulty of obtaining a correct sample of cream for testing?

3. Explain very carefully what you would do prevent error in the quantity of cream added to a cre test bottle.

If a mistake added 0.5 per cent. of fat to the test or reduced it by 0.6 per cent., what would be the loss in fat to the farmer and factory if he supplied 1,000 gallons of cream in a year at a correct test of 35 per cent.?

4. What is the action of sulphuric acid in milk or cream, and at what stage in the mixing of the acid with the cream is injury to the test more liable to occur? How would you determine the proper strength of acid for testing, and the quantity to use? Would the same strength and quality of acid suit different qualities of cream? Give reasons for your answer.

Will a light coloured fat or a dark colour increase the fat reading most? Explain your answer fully.

Time allowed—Two and a half hours.

1. State the chief conditions necessary to taking a correct sample of milk and cream for fat testing, and what effect may weather, preservatives, and low temperatures have on the test?

2. Explain the changes which take place in cream when it is souring, and what importance do you attach to these changes in making a test?

3. In testing the milk of individual cows for butter-fat, what precautions would you take to obtain correct results?

4. State the difference between the Babcock and Russian machines; also, the glassware used in each instance.

5. In the instruction of a student in testing, upon what points would you give special advice?

Time allowed—Two and a half hours.

1. When testing cows for milking competitions what precautions have to be taken to obtain correct results?

2. A cow gives 16½ lbs. of milk with a 5.2 test in the morning, and 14 lbs. with 5.6 test in the evening: what is the daily amount of commercial butter in ounces, allowing for a ¼ per cent. loss in separating and churning, and considering that commercial butter contains 85 per cent. of butter fat?

3. When instructing a pupil in milk and cream testing, upon what points has special advice to be given?

4. What precautions must be observed to get true average samples of cream out of cans?

5. Describe the principles of the Babcock test.

6. Make a sketch of the graduation on the necks of milk and cream bottles, and indicate how fat columns have to be read off.

7. Enumerate briefly the different operations necessary to test cream with a Babcock tester.

Time allowed—Two hours.

1. Describe minutely how you would proceed to obtain a true average sample of cream from a cream can. How does the condition of weather, the density and condition of cream, influence the corre

2. What are the sizes of milk a used for the Babcock test? Why a sizes chosen? What is the best pipette?

3. What kind of acid, what strength, and what quantity is used for a milk and for a cream test? What is the action of the acid, and how does the temperature of the sample and of the acid affect the tests?

4. What appearance must the fat column have to indicate that the test has been properly made? How must the fat column be read to obtain accurate results?

5. Describe fully the procedure for testing cream with a Babcock tester.

Bacteriology.

In this work it is not proposed to deal with the science of bacteriology, beyond that it should be shown how indispensable a practical knowledge of the subject is to those engaged in ordinary dairy work.

To milk and cream testing and grading, bacteriology has a marked application, as the writer has shown in the changes which affect the butter-fat contents and general character of the raw and manufactured produce.

At schools and agricultural colleges where dairying is taught, bacteriology should occupy the most important place in the science curriculum, and no diploma of any standing should be granted without the candidate showing a sound knowledge of the practice of the subject.

Here it may be remarked, that great changes are necessary in the system of dairying education followed Great Britain. Experience has shown the much is taught which cannot be profitably the duties of a dairyman, factory employee, instructor. Students should receive a training fitting them for service at home or abroad.

A Common Source of Milk Contamination.

The following example will show how milk becomes inoculated with germs, which may exercise a hurtful influence on the work of the tester and grader.

Procuring the necessary bacteriological appliances used in the growing of germs, the writer proceeded to a dairy in a southern State, in company with the chief sanitary inspector for the city. On arrival, the

owner of the dairy was engaged milking the cows, and from the uncleanly conditions of the cow and the milker a good opportunity of securing descriptive bacteriological specimens were in evidence. Selecting a cow, the writer proceeded to dust the udder free from the large particles of dirt and adhering pieces of straw before exposing the plates of transparent germ food. When the udder appeared somewhat clean, one of the plates was held immediately under it for forty seconds, and, after a lapse of ten seconds, a second plate was exposed to the finer particles of dust, for one minute. The plates were put in an incubator, and two days after sowing both were photographed.

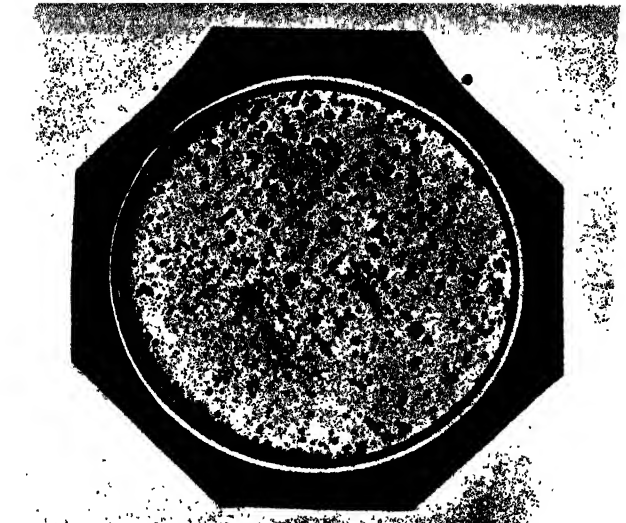
No. 1 shows distinctly a number of hairs which had fallen from the cow's udder, and along their lines is seen an accumulation of bacterial life, while many colonies of organisms cover the culture media. No. 2 also illustrates numerous colonies, which proves that of the cow is a very fertile field for germs. were the udders and teats of the cows dirty at ticular dairy, but the milker had acquired that able practice of dipping the hands into the pail at short intervals during the process of milking; in other words, the teats of the cows were undergoing washing, which caused serious contamination of the general milk supply, and considerably reduced its keeping qualities. To reproduce evidence of this injurious practice, the writer filled one of the sterilised tubes with a quantity of milk from a pail which was set aside, and which represented the yield from one cow. A second tube was partly filled direct from another cow by the milker while engaged stripping.

Before these plates were exposed to the falling dust, their photographic appearance was spotless, likewise were all other plates previous to cultivation of germs.

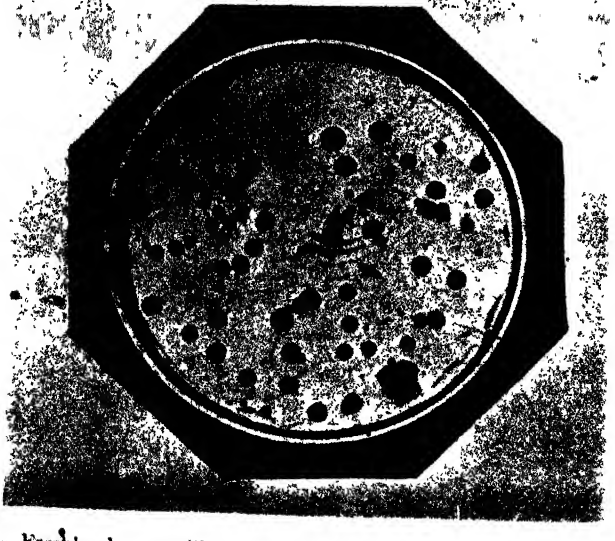
No 1.—From dirty udder, showing germ growths around hairs. Large colonies are from scales and particles of dust. Exposure of plate 40 seconds.

No. 2.—Colonies from the same udder after exposure of a second plate for 60 seconds.

3



4

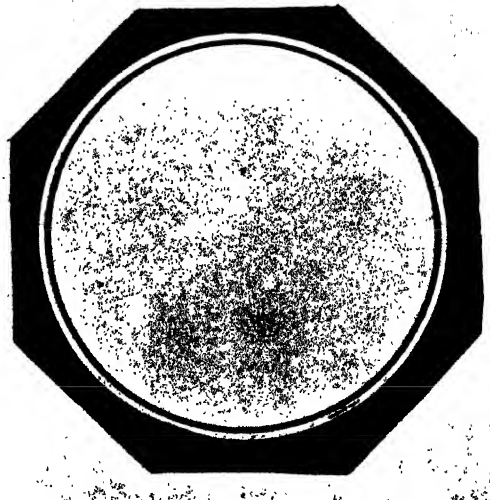


No. 3.—Freshly drawn milk contaminated during milking Colonies of bacteria are from one drop of milk.

No. 4.—Milk strippings contaminated during milking (one drop).

A

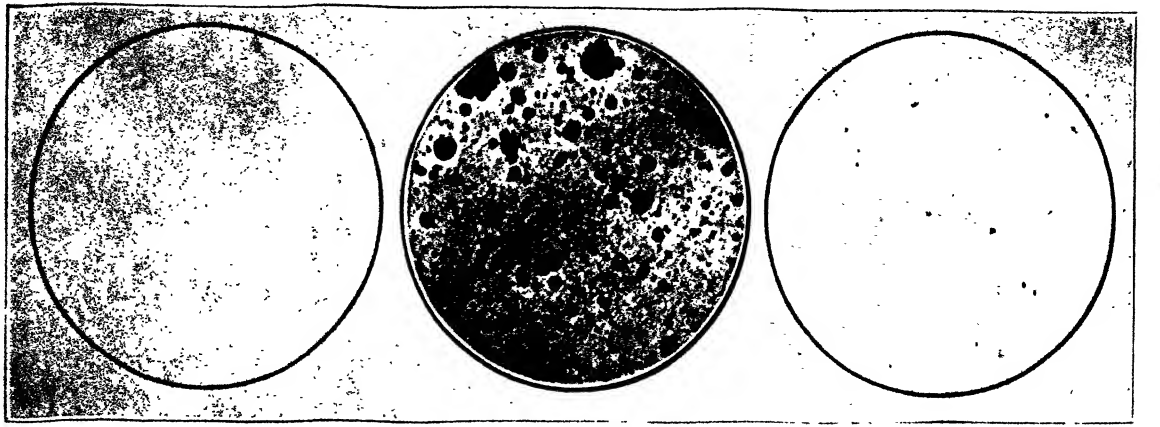
B



A.—Tainted factory milk, illustrating numerous colonies of bacteria and mould from one drop.

B.—Sterilised milk free from colonies.

A.—From dirty atmosphere.
B.—Plate culture from good butter. All are colonies of lactic organisms.

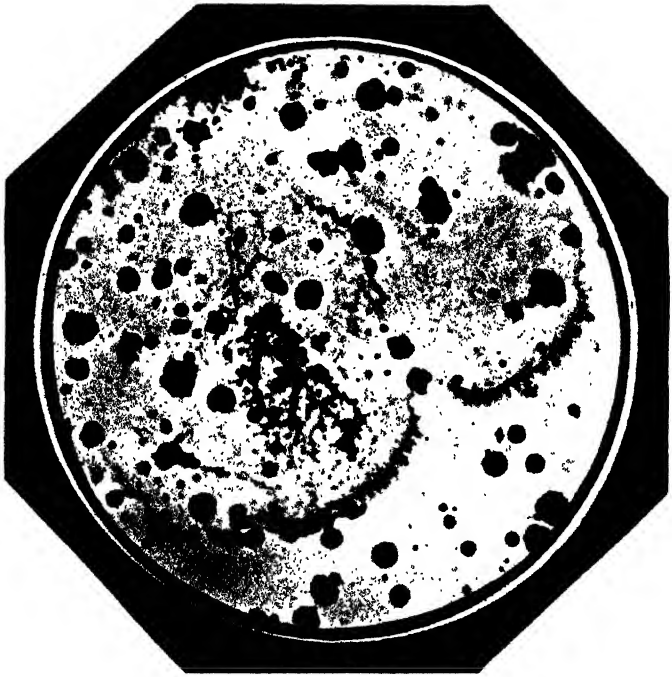


Appearance of plate containing germ food ready for the experiment.

After gently brushing the udder of a cow, plate was exposed for 20 seconds to the falling dust. The colonies of germs seen in the plate developed in two days, thus illustrating the number of acid and taint-producing organisms that fall into the milk pail when proper precautions are not adopted before milking.

After dusting and damping the udder of the same cow, plate was exposed for 60 seconds. Few colonies are visible, proving the great necessity for universally following the practice recommended by the writer.

One drop of milk from each tube was sown on plates, and the germs cultivated, proving the extraordinary number of bacteria in the samples (Nos. 3 and 4). It will be observed that the strippings are very fertile,

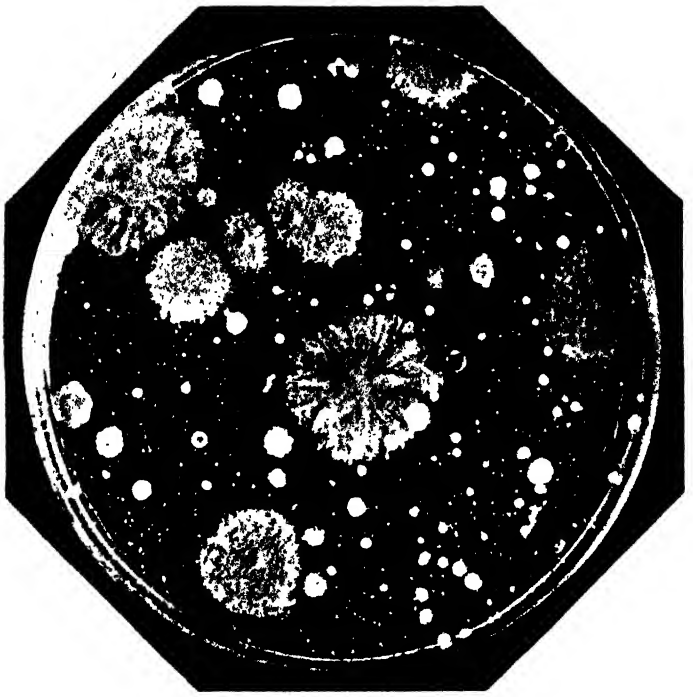


From contaminated air in milk and cream room. Colonies represent hurtful bacteria, viz., red, violet, yellow, and white. Moulds are also present. Exposure of plate to the air, 10 minutes.

which is proof that contamination may come from the milker's hands.

A convincing evidence of contamination of milk is shown when supplies are examined on delivery from

farms. It frequently occurs that the surface of the milk or cream in the cans is discoloured with particles of dirt,

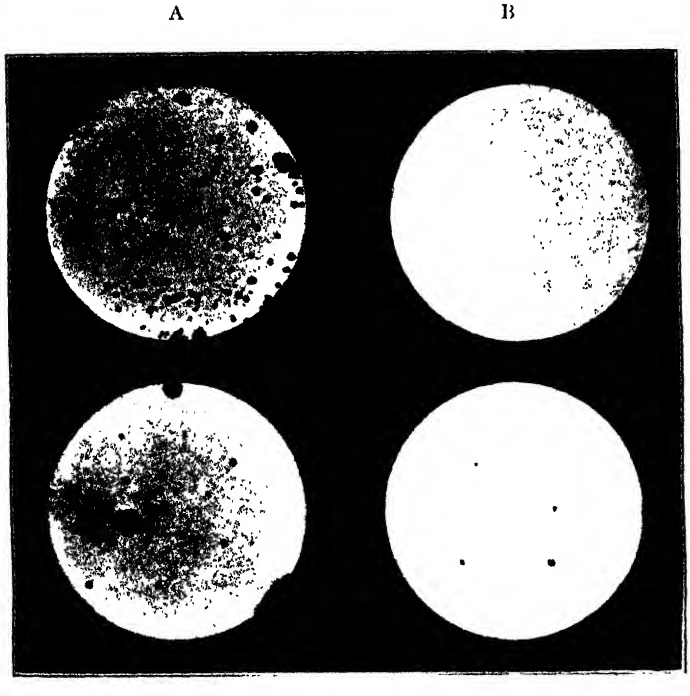


CULTIVATION OF MOULDS AND BACTERIA FROM THE HEART OF A CHEDDAR CHEESE.

Where care is not observed in the cleanliness of rooms used for the storage of dairy produce, the seeds of injurious moulds and germs, which are abundant in dirty rooms, get into the milk supply and cause damage to butter and cheese.

pieces of straw, hairs, and other forms of foreign matter, and contamination is confirmed by the accumulation of dirt commonly observed in the milk-strainer at dairy farms.

From what has been said and supported by the bacteriological plates, it will prove to readers how milk is contaminated during milking, and everyone will agree



WATER CONTAMINATION.

A. Untreated water. B. Boiled water.
C. Scalded water. D. Filtered water.

that the danger can be lessened by introducing a system of rubbing the udders of the cows with a damp cloth, and by enforcing care and cleanliness in other departments of the dairy. It is recommended to wash the udders

of the cows when a damp cloth is insufficient to remove the dirt, but the teats should be washed and dried before milking commences.

Dairy bacteriology will be more fully dealt with in "Dairying for all Countries."

CHAPTER III.

GRADING OF PRODUCE.

MILK.

THERE is no scientific test known to the writer that can be applied to determine the flavours in dairy produce, and it is unlikely that any apparatus will be invented to take the place of the nose and palate. These organs are exceedingly sensitive in some people, while in others a dullness is found that unfits the person to act as a competent judge of flavours. A judge must be able to accurately use the faculties of smell and taste, and by a quick application of thought give a ready decision as to the character of the substance under examination. In some parts of the Continent very great importance is placed upon the inspection of milk by trained graders, and it is surprising that some system of examination is not carried out in all cities where milk is handled in large quantities for consumption in the raw state.

In grading milk the general practice is to shake a sample thoroughly in a vessel. This is subjected to the scrutiny of the nose and palate, and if found normal the milk is accepted on the basis of flavour.

The defects commonly met with in milk are cowy,

weedy, acidy, and stale flavours. The two former are subject to elimination in the process of cooling and aerating, while the latter are of too evil a nature to pass unchallenged. Speaking of staleness, there is perhaps no more serious a taint to be found in dairy produce, and when it is detected, no doubt should exist in the mind of the judge as to what action should be taken in deciding the proper place for the unwholesome product.

Testing for Acidity.

It is of great assistance to wholesale buyers of milk and to the butter-maker and cheese-maker to be in a position to test milk supplies for acidity. This can be done by the use of a simple apparatus called an acidimeter. It is also most valuable as a means of detecting the presence of acid preservatives in milk and cream and in indicating changes in milk which unfit it for manufacturing purposes.

Grading points for milk:—Flavour, 60; body, 30; colour, 10—total, 100.

Cream Grading.

The writer has at all times been an enthusiastic advocate of the compulsory grading of cream at factories. From a close observance of dairying in his late official capacity in Australia, he realised the very grave danger ahead of the industry through the many evils common to the production, handling, and purchase of cream, and which were being deeply reflected in the quality of the butter shipments to England and other parts of

the world. After investigating all branches of dairying, having a close relationship to a promising export trade, the writer decided on the compulsory classification of butter, as the only means of drawing the serious attention of the factories and exporters to the possible ruination of the whole industry. Fortunately this action had the desired effect, and when the much-needed reforms were sufficiently advanced, the compulsory grading of cream was added to the laws of Queensland dairying. With this valuable regulation in force, and effectively carried out, no Australian State need fear harm from the strongest competitor in the butter markets of England, as it will give to the industry the strongest link in the chain of successful production and export.

Some Dangers Militating against Cream Grading in Export Countries.

The purchase of inferior milk and cream at top prices (arising from very keen competition and bitter antagonism amongst factories) has become a recognised thing in many dairying districts in Australia and in other countries. One factory may rigidly enforce measures towards keeping up the standard of quality of their manufactured products, by paying for milk and cream according to its purity and richness, while other factories are striving regardless of reputation, to add to their patrons by accepting the raw produce at the highest price irrespective of its condition. What follows this suicidal policy? Encouragement is afforded suppliers to become careless in the treatment of milk and cream, and instead of the factory

extending its sphere of usefulness to a district and being of educational value to its suppliers, it becomes a source of evil to the whole industry.

Disruption amongst suppliers and factories follows in its wake, the laws of honest trading are broken, all of which act most injuriously against the future prosperity of the farmer. This recklessness is particularly evident in the vitally important branches of dairying which affect the supplier most of all, namely, the taking and testing of samples of cream and grading the same according to its quality. With no distinction in price between good and bad cream, how can cream grading be successfully done, especially where pooling is looked upon as a legitimate element of the industry? The produce of factories participating in evil practices cannot be relied upon in a way that will give confidence to buyers. This is characteristically illustrated in the official grading at Australian ports of shipment, where all qualities and conditions of butter are found under the one brand. How can it be otherwise than disheartening to grading inspectors when their faith in the classing of butter at the factory is shattered, and how can they examine every box in a shipment of thousands of boxes so as to guarantee the reliability of the official stamp? Grading has brought to the clear light of day what was crippling the butter trade of Australia as a national industry.

Reforms Essential.

To prove the necessity for reforms on the lines suggested in this chapter, the writer will give practical evidence of hurtful conditions which can readily be

prevented. Take the acidity of milk as a chief cause and the instance to follow of milk supplied to a factory by six dairymen for six successive days, as a proof of the danger.

The price paid for this milk was according to fat test only. It will be necessary to point out to readers that fresh milk should not have more than 0.19 per cent. of acid.

PERCENTAGES OF LACTIC ACID IN MILK.

	Per cent.	Per cent.	Per cen	Per cent.	Per cent.	Per cent.
1	0.27	0.55	0.23	0.26	0.22	0.26
2	0.26	0.24	0.24	0.23	0.24	0.24
3	0.27	0.23	0.23	0.21	0.23	0.25
4	0.24	0.23	0.22	0.25	0.25	0.23
5	0.20	0.20	0.19	0.20	0.19	0.19
6	0.19	0.20	0.19	0.19	0.21	0.21

The last two suppliers' milk was well looked after, not only in the process of milking, but it was aerated and conveyed to the factory in cans over which a canvas envelope well saturated in water was put. These careful farmers got no monetary encouragement from the factories to continue to attend to the keeping property of the milk, the same price being given for the sweet and acid supplies in which the fat test compared. Had a distinction in price been made, the neighbouring factory would have gladly accepted the acid milk, with an extension of sympathy to the supplier for the unjust treatment meted out to him in the refusal of the other factory to take his milk. This applies more forcibly to cream, and with much worse results.

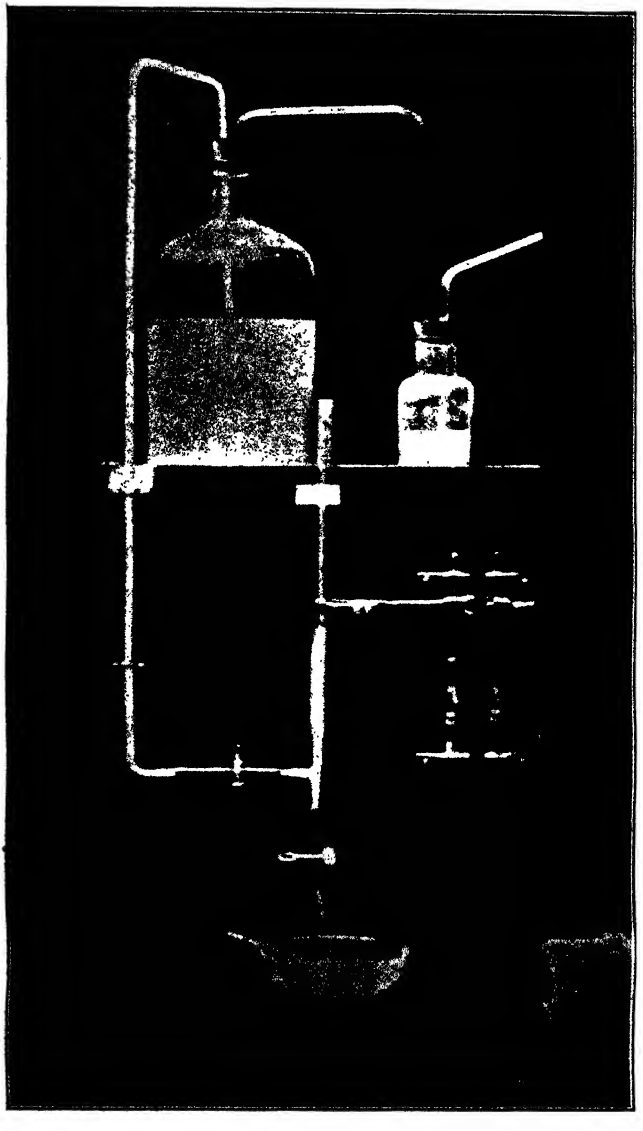
PERCENTAGES OF LACTIC ACID IN CREAM.

	Supplier.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.
		Per cent.	Per cent.	Per cent.		Per cent.
Original package, thrice weekly	A	0.40 ripe	... acid present	0.36 acid present	...	0.34 acid present
Pooled cream, thrice weekly	B	0.48 stale	...	0.44 stale	...	0.34 ripe
Daily delivery, pooled	C	0.39 ripe	0.32	0.34 acid present	...	0.30 acid present
Daily delivery in original can	D	0.27 sweet	0.25 sweet	0.23 sweet	...	0.24 sweet

On the basis of the fat test the same price was paid for this quality of cream, and the dumping ground for the butter was London. Evidence of the great worth to an industry of sending a daily supply of milk or cream to the factory in the original can, is well supported by the above, and should appeal to every progressive country. The writer would recommend the introduction of tables for use in factories, and arranged as follows :—

ACID TESTING IN BUTTER-MAKING.

Date.	Per cent. Acid in Cream when received.	Per cent. Acid in Cream at Churning.	Per cent. Acid in Buttermilk.	Remarks.



ACIDIMETER.

ACID TESTING OF MILK SUPPLIES.

Date.	Name of Supplier.	M. per cent.	T. per cent.	W. per cent.	T. per cent.	F. per cent.	S. per cent.	S. per cent.	Remarks.

ACID TESTING IN CHEESE-MAKING.

Date of Manufacture.	Percent. Acid at Rennet-ing.	Percent. Acid at Cutting.	Percent. Acid at Whey running.	Percent. Acid at Press-ing.	Age of Cheese at Maturity.	Quality of Cheese.	Remarks.

The losses to the industry through acidity of milk assumes alarming proportions each summer. An enormous reduction could be made in the monetary loss if the dairy farmer would expend a little time and trouble to retain a sweet condition in his milk supply. Want of perseverance and a reluctance to adopt improved methods is still the characteristic trait of many dairymen. Simple devices could be adopted with good results, and milk would remain sweet for hours longer in the heat of summer.

ACID TESTS OF FRESHLY DRAWN MILK.

The results of the three following tests are of singular importance. It may be well to explain that these

acidity determinations were made for one month. In taking samples, equal quantities were milked from a test cow into sterilised vessels of similar shape and capacity, and acid tests were immediately taken. The samples were kept under exactly the same conditions and the readings were noted from each quantity of milk examined at the same hour. It will be seen that the first milking is higher in percentage of acid, and the last test shows that the acidity has increased against the middle milk, while the strippings kept a shade better than the middle sample.

For comparison we will take a few others, giving the first and last readings and omitting the intermediate tests.

	Duct Washing.	Middle Milk.	Strippings.
	Per cent.	Per cent.	Per cent.
First Test - -	0.21	0.19	0.19
Last Test - -	0.40	0.35	0.34
First Test - -	0.19	0.18	0.18
Last Test -	0.40	0.30	0.34
First Milk - -	0.20	0.19	0.19
Last Milk - -	0.40	0.35	0.34
First Milk - -	0.19	0.18	0.18
Last Milk - -	0.37	0.34	0.33
First Milk - -	0.20	0.19	0.19
Last Milk - -	0.38	0.34	0.33

The average for the duct washing may be taken at 0.20 per cent. acid, middle milk 0.19, and strippings 0.19.

Acid Determination of a Cow's Milk.

Milking.		Acid Readings taken.		Duct Washings.		Middle Milk.		Strippings.	
Date.	Hour.	Date.	Hour.	Acid.	Remarks.	Acid.	Remarks.	Acid.	Remarks.
				Morning Milk.					
				Per cent.		Per cent.		Per cent.	
March 18	8.20 A.M.	March 18	8.30 A.M.	0.20	...	0.19	...	0.19	...
			11.30 A.M.	0.21	..	0.19	...	0.19	...
			5 0 P.M.	0.22	...	0.20	...	0.20	...
		March 19	11.45 A.M.	0.26	...	0.23	...	0.22	...
			3.10 P.M.	0.28	...	0.24	...	0.24	...
			6.5 P.M.	0.34	Partly thick.	0.30	...	0.29	...
		March 20	7.30 A.M.	0.38	Thick.	0.34	Thin.	0 33	Thin.
				Evening Milk.					
March 18	5.20 P.M.	March 18	5.30 P.M.	0.20	..	0.19	...	0.19	...
			6.30 A.M.	0.22	..	0.21	...	0.21	...
			11.30 A.M.	0.24	...	0.22	...	0.22	...
			6.10 P.M.	0.28	...	0.25	...	0.24	...
			10.40 A.M.	0.37	Thick.	0.34	Thin.	0.33	Thin.
				Morning Milk.					
March 19	8.20 A.M.	March 19	8.20 A.M.	0.20	...	0.19	...	0.19	...
			11.30 A.M.	0.22	...	0.20	...	0.19	...
			5.35 P.M.	0.25	..	0.23	...	0.22	...
		March 20	9.0 A.M.	0.27	...	0.25	...	0.24	...
			12.5 P.M.	0.31	...	0.27	...	0.26	...
			2.15 P.M.	0.34	Thick.	0.3	...	0.29	...
			5.0 P.M.	0.39	Thick.	0.35	Thin.	0.34	Thin.

Payments Based on Flavour and Fat.

It is a well-established fact amongst practical dairymen that the fat proportion of cream is not a guarantee that the flavour is first class, and if a supplier keeps rich cream until it is tainted he should not be paid the highest price for it. Until flavour is universally acknowledged as a principal factor of payment, remedial measures to raise the standard of cream will be greatly robbed of their true worth to the industry, and the education of suppliers to guard against evils ruinous to the product discouraged. It cannot be denied that the system followed in some countries is very objectionable to dairymen, who are doing everything that their means and ability will allow to improve their dairies, and comply with the requirements conducive to a good supply of cream, but unfortunately the painstaking are made to suffer for the deeds of the careless.

EQUIPMENT OF FACTORIES FOR GRADING.

What a Cream Grader should know.

The knowledge required for the position of a cream grader should exceed that of an inspector of milk by a very great deal, and in qualifying men to undertake this vital duty no leniency should be shown by examiners. Cream classing involves great responsibilities, and the knowledge cannot be hurriedly acquired. In fact, it would be dangerous to grant certificates to men who were unable to show evidence of at least ten years' practical experience in the most important work of factory management. The syllabus which the

writer prepared for the Queensland Government four years ago, embraces many questions in the science and practice of cream classing, and in preparing for examinations of this kind students should have sufficient evidence to warn them not to treat the subject lightly. A thorough practical examination should be entrusted to competent experts only, who would use care and discretion to make the test in every way worthy of the subject. Cheap certificates are valueless to the holders, and hurtful to employers, and strong efforts and inducements should be made by those in authority to increase the desire among factory hands to aim at the highest scale of proficiency in whatever branch of work may be undertaken. And were this done the status of dairy-factory education would quickly be elevated, and encouragement given to men of ability and energy to find employment as butter and cheese makers.

What He Should Guard Against.

Possessed of a practical knowledge of his subject, the grader will be in a position to quickly detect faintly perceptible taints, most important of which are those responsible for the low keeping properties of butter, commonly met with in aged supplies of cream. Anything of a stale quality, though perceptible and no more, should be unhesitatingly classed as a second grade, for the reason that a small quantity of cream, in which the first stage of decomposition has set in, when mixed with gallons of sound cream, will destroy the good flavour of the butter after refrigeration and thawing.

This has been conclusively proved in tests made by the writer, and which are referred to in the subject of butter grading. The factory grader, upon whom this delicate duty devolves, must recognise that his judgment and ability to class cream is not determined by the flavour of the butter on the day of churning; that is absolutely no test, and should

Cream Grader's Squeegee, used in the cleansing of the mixing-can.

not be recognised as such. Sufficient time should elapse before determining the quality of the butter, so as to ascertain if the good flavour is set, or has a permanency in the product. If carelessness or incompetency has been shown in the mixing of creams, the butter from the cream will betray the weakness of the grader after it has been chilled and thawed, although

on the day after manufacture it may have all the characteristics of a choice product. Experience of grading has shown to the writer that the blending of a pound of stale cream with fifty times its weight of the choicest quality will give to butter when a few days old no indication of its presence, but a fortnight's cool storage, followed by rapid thawing will cause a stale smell to be emitted, and which may only be detected by the skilled grader. Export butter of this quality should be viewed with strong suspicion, and, no doubt, its exposure for a few days to the influence of an English atmosphere would change the grade from a first to a second or third quality.

The Practice of Grading Cream.

To effectively classify cream into its respective grades requires a faultless palate, keen sense of smell, and a good practical knowledge of flavours and defects common to the dairy. To preserve the senses of taste and smell, the grader should not be a smoker, or abuse his palate in any way. His work should be carried out on a systematic basis and not haphazard. His first duty is to arrange the cans of cream methodically, and to test each one for odour, which can most effectively be done immediately the lid is removed. It should, therefore, be an understood order in factory management, that no person but the grader should take the lids off the vessels. Where a taint is in cream and if at all volatile, as most of them are, particularly in warm weather, the air space over the cream will be charged with the bad gases, and these

will be liberated on the opening of the can. The next duty of the grader is to mix the cream in the "original" can to obtain an even consistency for the flavour test.

This important duty is frequently performed by a factory assistant who, equipped with a thick stick, goes from one can to the other, stirring each in turn. What is the result of this practice? Good cream is heavily inoculated with cream of an inferior quality, for every can in a big consignment is seldom if ever choice. Fermentation follows, and although as already pointed out, the evil may not be noticeable in butter immediately after manufacture, it invariably presents itself at a period most damaging to the reputation of the brand, and the manufacturer. Again we have the custom of forcing the hand into cream to judge the flavour and consistency, and which is usually repeated without cleansing the hand until all the cans have been tested. Although this may not be so hurtful to the product as the stick, it should not be permitted in well-conducted factories.

TESTING THE SAMPLE.—In testing samples the use of the finger is recommended, and as soon as the examination is over, the finger should be cleaned. As the work entails considerable strain on the palate, it is unwise to swallow even small quantities of choice cream. To facilitate accurate work the writer would suggest that the grader wash the mouth out with warm water at intervals. It may be queried here as to the use of the finger, and the reason offered is that to make the test by means of a piece of bone or wood

causes an interference with the palate, which does not apply to the warm natural skin.

Let us now return to the cans of cream which have been tested for odour, and stirred in a correct manner.

In cases where the flavour is found satisfactory in cans which gave a stale odour, such a quality of cream may be classed as doubtful, and unsafe to mix with a first-rate product. It is here where a mistake is frequently made, as the writer has repeatedly proved in the examination of butter manufactured from cream of the above quality. As each can is tested, it should be put in its proper row, and where a doubt exists in the mind of the grader, he should call in his most competent assistant in arriving at a decision. After classing, the cream passes through the straining process and goes direct to the ripening vats, where each grade is separately handled.

The keen observance and attention of the grader should be directed to the proper mixing of the cream in the vats, so that an even ripeness will be obtained, no part of the cream showing more or less acid than another, the distribution being thorough. To effect the successful treatment of cream, the mixing requires to be done the day previous to churning. A steady temperature with a pure atmosphere, and a well-regulated agitation in the vats must be maintained.

Grading by Points.

It is recommended to grade cream on the following scale of points :—

Flavour - - - -	60
Body and Texture - -	30
Colour - - - -	10

This should form the basis of the factory grader's decision in classing the cream, and to assist him the use of the acidimeter is recommended. The application of the instrument will guide and train the palate to attest the degree of acidity of the cream, thus helping the grader in the final classification.

In bringing his faculties to bear on the primary element—flavour—fresh cream should have a choice sweet flavour, the faintest indication of anything of a foreign nature being absent.

When the proper degree of acid has developed, and the product is ready for churning, the flavour should be pleasantly sharp, followed by a little sweetness; when over-ripe the sweetness disappears and a harsh acid predominates; if under-ripe the acid flavour will be found to be weak, and the sweetness marked.

BODY AND TEXTURE.—The cream should show an even consistency, firm in body with a velvety surface. When poured from one vessel to another a faint granular appearance should be noticeable.

There should be no clots or lumps in the cream, a condition frequently arising from the mixing of warm and cold supplies, which vary in density, and the presence of churned or half-churned granules of butter shows a faulty condition. The cream should also be free from ropiness or sliminess arising from contamination from bacteria, diseased udders, cows long in milk,

inferior herbage, also from cleaning separators in strong alkaline solutions, and not washing away all traces of the soap.

COLOUR: UNIFORM THROUGHOUT. — Free from whiteness caused by poor food, and breed of cows, freedom from red streaks or a yellow colour indicative of diseased udders, colostrum, or injurious bacterial changes.

STORAGE OF CREAM.

The storage of cream on the farm is, in a number of instances, compulsory, owing to a frequent delivery being prevented by long distances from railway stations, depots, and factories. In such cases, special consideration should be given to the conditions under which the product is kept, with a view to retard fermentation in the cream and injury to the quality of the butter. As already pointed out, the dairy or cream store-room should be thoroughly protected against the agency of heat, and at the same time light and ventilation must not be sacrificed to attain this object. If the dairy is provided with an underground cellar, special precautions are therewith necessary, and in the cold months of the year it is advisable to keep the cream in a warmer and purer atmosphere, to prevent the development of bitter and otherwise injurious flavours. Low temperatures are no doubt indispensable in the hot months of the year to check ripening, but in the winter weather the fermentation or the growth of the lactic organisms has to be encouraged.

Special precautions are also necessary in the factory

to safeguard against damage through the storage of cans in the cool chamber. This is a customary thing in small factories, but to obtain regularity in acidity or ripening, the use of cream vats, situated in an atmosphere wherein an outlet and inlet for air is provided, gives the best results in quality and yield of butter. There is also to be considered the suitability of the pumps and other appliances used in the treatment of cream, for it is known to the writer that much damage has been done to butter through the defective construction of pumps, and the imperfect cleansing of same.

Salting Cream.

The addition of common salt to preserve home separator cream, is sometimes practised at the recommendation of managers, who use it in their factories for a similar purpose. Salt no doubt increases the keeping properties of cream to a small extent, but a sound product is injured through its use. The action of salt is, in the opinion of the writer, to hold the good flavour, not to develop it; and the proper time to add the preservative would be when the cream is in the vat, and the acidity likely to develop to excess before churning.

Butter Grading.

Government Supervision of Exports.

The classification and grading of dairy and agricultural exports on practical, scientific, and commercial lines has received the writer's arduous study during twelve years of official service in Australia. In support

of the system which the writer had the good fortune to inaugurate in Queensland, he has written much and has carried out many elaborate and convincing experiments in the face of strong and determined opposition. But the inspection of exports has steadily raised the position of Australian butter from a state of chaos to one of the highest in the world's markets. This advance has richly rewarded the agriculture of the country, and the British public have enjoyed the protection which official grading so well affords.

The writer would strongly recommend that all oversea countries that depend upon the British markets for the disposal of their surplus produce, should not hesitate to make the grading of exports the stronghold of their trade. The splendid example of the Australian Commonwealth Department of Customs should be followed by every export country.

The action of the Commonwealth in controlling the grading of dairy exports is the most progressive step ever taken in the interests of the dairying industry of Australia. It is to be hoped the Federal Government will widen its sphere of usefulness and include the inspection of all perishable exports, also factories and dairies. When this is done, Australia should have nothing to fear in the meat and dairy produce markets of the world.

Instructions in the Grading of Butter.

The subject of butter grading is too comprehensive to be fully dealt with here. The writer will therefore

confine himself to the work which is essential to the successful application of the system.

Duty of Managers.

Grades of Butter.—A factory manager should give special attention to the grading of the cream, for without this the reputation of the factory's brands of butter would suffer injury in the open markets, caused by the uneven condition of the butter and its low keeping qualities. There should be made in every factory at least three distinct grades of butter—first, second, and third—and these should be packed in boxes bearing different brands to distinguish the one from the other. Under the first-class brand superfine butter would be included, and pastry butter would be kept apart from the third grade.

Churning Number.—To safeguard still further the interests of the factory and the manager, a churning number should be put on each box, which would denote to what churning the butter belonged, and also the date of manufacture should be given.

Grading at the Factory.—All managers should grade a box of butter from each churning, and keep an account of it in a special book. A comparison could then be made with the official grader's report.

Visiting Cool Stores.—Managers should visit the cool stores at shipping ports as frequently as possible, and class their butters with the official graders. Differences of opinion in the awards could then be settled satisfactorily. Graders should likewise visit the factories and acquaint themselves with the existing

conditions, and learn the defects and peculiarities of districts, all of which have an influence on butter.

Qualifications of Managers and Graders.

To attain proficiency in the grading of butter a keen palate is necessary, and nothing should be allowed to interfere with either the sense of smell or taste. Tobacco and alcohol are hurtful agents, and certain foods, such as onions, may act very seriously on the sharpness of the palate. Digestive disorders likewise add to the possibilities of error in the examination of butter.

Knowledge Required. — A knowledge of the practice of dairy farming greatly assists a man to examine butter, and he should understand the theory and practice of cream ripening and buttermaking. A study should also be made of scientific subjects which have a close relationship to flavours, for without this education difficulties will be found in determining the cause of taints and defects in produce. In the opinion of the writer an acquaintance of the science of dairy bacteriology is invaluable to the grader.

The duties and capabilities of a butter grader should go further than merely class produce in its respective grades; he should be qualified to explain the cause of a bad flavour, how to obviate it, and what changes may follow when butter is stored at different temperatures.

Climate and District.

This is a subject of more than passing interest, and it is one which requires strict attention. It is

well known that district exercises considerable influence over the solidity of butter, and in countries with different climates—temperate, sub-tropical, and tropical—many valuable illustrations of the necessity for the grading of butter at suitable temperatures have been given. Some butters show up best at a temperature of about 45° Fahr., but when raised to 60° Fahr., the whole body breaks down and presents a spongy appearance. This shows the necessity of a knowledge of climate and district when classing a factory's produce, as there are characteristics in the butter which are indigenous, so to speak, to the district from whence it came. Again, some butters, although sound in character to the ordinary palate, possess poor keeping properties, and *vice versa*.

When to Grade.

The true properties of butter cannot be recognised until the predominating flavour becomes fixed in the butter, which takes a few days. Freshly made butter is deceptive for this reason, and no definite opinion of the quality—except in cases of low grades—should be given until the raw or immature flavour has disappeared. This is very noticeable in some butters of choice quality, the harsh flavour of the salt remaining in the butter for two or three days, when it is supplemented by a more mellow flavour, showing the fixed flavour of a fine product. The writer will deal with this subject under the title of "Fixity of Flavour."

Light and Temperature.

The examination of butter should be conducted under the most suitable conditions of light and temperature. Artificial light is very unsatisfactory, it being impossible to determine defects in colour and texture with the aid of an oil lamp or the electric light, as there are different shades of colour in butter which respond only to the influence of daylight.

Butter should be graded at temperatures ranging from 45° Fahr. to 55° Fahr., and the experienced judge very quickly knows if the butter is in good condition for testing when he places the iron in the box. The butter should be firm, not hard, should pull readily, and in returning the sample no difficulty should be experienced in freeing the iron of the butter. The object of the grader is to sample the produce at a temperature most favourable to the detection of the different flavours, some of which are more volatile than others. If the temperature of some butter is too low, delicate flavours will not be detected, and if too high the soft texture will interfere with the flavour. The temperature of the grading-room should be higher than the butter, this condition favouring the escape of volatile gases from the butter, and which the grader endeavours to catch when the iron is passed under the nose.

Crude Methods of Sampling.

Sampling butter for grading purposes should be done with a well-made iron, and upon no account should the finger be used or a knife or a piece of

wood to remove a quantity of butter to be tasted. When this is done it is impossible to do full justice to the butter, as the aroma cannot be detected, and the flavour, if not sufficiently pronounced, will not show up on the palate. The writer would strongly advise all factory managers to get a complete grading outfit, so that they may be in a position to thoroughly sample their butters from the box, and if this were done defects would be more readily recognised and eliminated. By the use of the iron streakiness, mottles, uneven colours, and the texture of butter can be fully demonstrated, and these are defects which managers should guard against in the manufacture of butter.

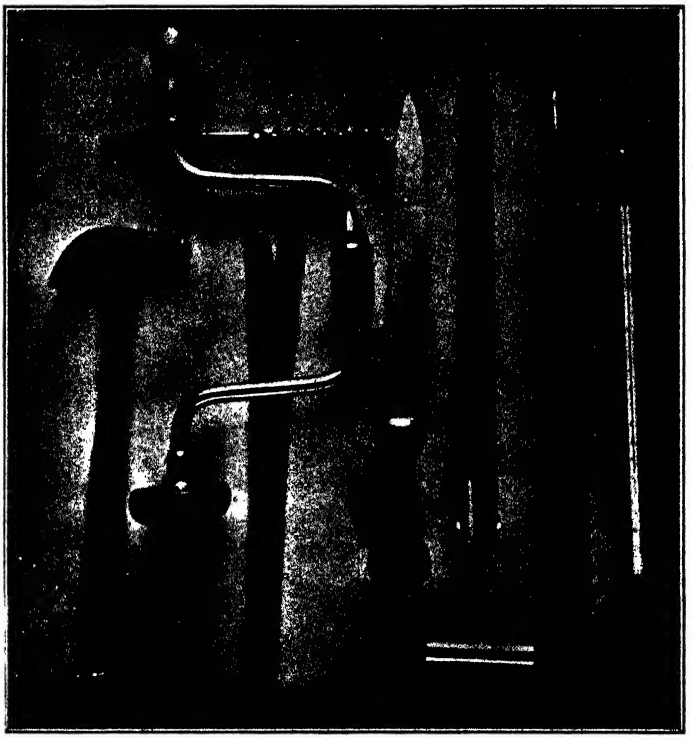
How Grading should be done.

Equipped with a good iron, thoroughly clean, a supply of small pieces of linen, a thermometer, and other accessories of lesser importance, the grader is ready for work.

The first operation is to take the temperature of the butter and to note the surface for evenness and general finish. To make a thorough test of this, the block of butter should be removed from the box and the outside packing examined. It should then be weighed. The butter is now returned to the box and the grader takes the iron and carefully forces it through the full depth of the block of butter at a slight angle; turns the iron carefully to cut the butter, and then draws the sample. In doing this care is taken not to enlarge the opening, and if the sample is properly taken the cut will be smooth, and the butter on the

iron will show no disfigurement through defective sampling.

Immediately the sample is drawn the iron should be passed under the nostrils and the butter tested



BUTTER GRADER'S OUTFIT.

for aroma, after which a bite of the butter is taken from the iron to determine the flavour.

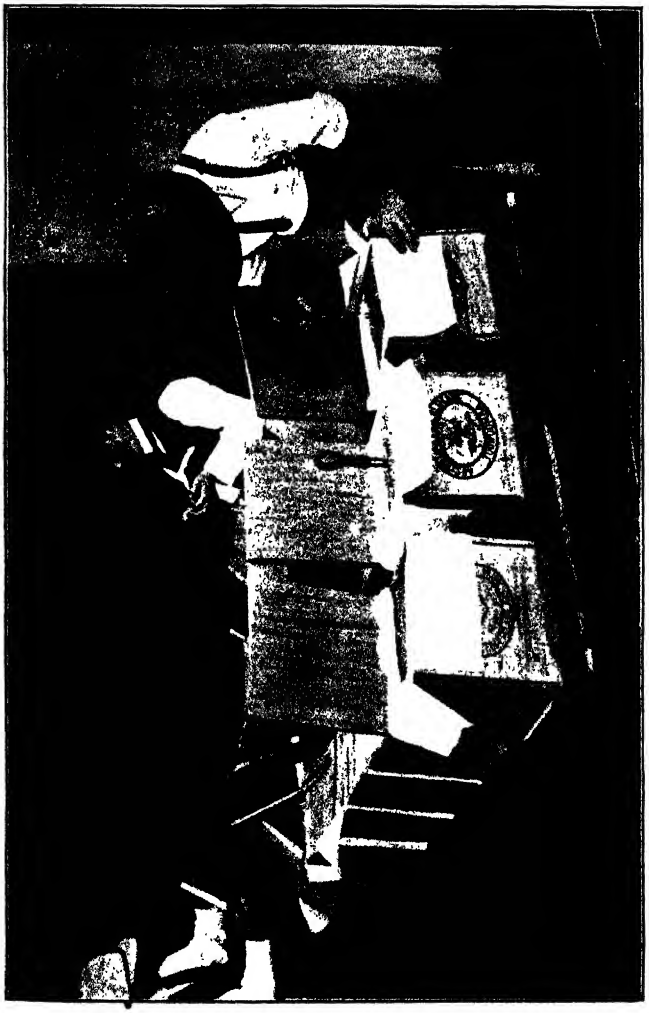
As soon as the mouth contains the butter it should be searched by the palate for a few seconds,

Quality of Butter.	Aroma.	First Flavour.	Second Flavour.	Final Flavour.
Insipid or weak butter of sound quality	Faint	Very delicate	Delicate	Distinct, sweet, and clean.
Faintly stale	May be very good	Clean and attractive	Faint signs of age	Age distinct.
Slightly stale	May be good	Clean	Signs of age	Age pronounced.
Stale	Usually rancid	Age	Age pronounced	...
Very stale	Usually strong	Age pronounced	...	...
WHERE AROMA ASSISTS AND DECEIVES.				
Faintly stale	Aged	Clean	Dull	Age distinct.
Weedy	Weedy	Good	Mixed	Weedy.
Weedy	Attractive	Common	Weedy	...
Slightly tallowy	Attractive	Clean	Clean	Tallowyness pronounced.
Slightly fishy	Good	Very attractive	Attractive	Fishiness pronounced.
Bitter	...	Good	Faintly bitter	...
TESTING THE FIXITY OF FLAVOUR IN BUTTER.				
Tested day of manufacture.				
Weak	Nil	Very weak	Weak	Creamy.
Tested two days after manufacture.				
Improved	Attractive	Weak	Creaminess pronounced	...
Tested three days after manufacture.				
Very good	Attractive	Good, flavour pronounced	Very distinct	...
Tested day of manufacture.				
Mild	Nil	Raw and salty	Good	Very choice.
Tested three days after manufacture.				
Very good	Attractive	Choice	Very choice	Sweet.

then allowed to dissolve, slight movements of the tongue assisting this. While it is dissolving, the mind should not be concentrated on the butter at all, and there should be no noise to distract the grader. When the butter is melted he should bring his faculties to bear on the flavours. In this manner it is possible to detect in butter of average quality three different flavours. The last flavour may prove the most valuable as a guide to the classification of the butter. It may be illustrated as shown on previous page.

When the grader has fully dealt with all defects in flavour and recorded the result in his entry-book, he proceeds to examine the texture, colour, and finish. Great care is taken in testing the texture, for it is known that a butter may have a good flavour and yet go "off" readily owing to such weaknesses as milky brine, watery, open, and spongy texture. Such a butter would meet with the requirements of the local market, but when it has to be exported thousands of miles something better is required to withstand the test of time. It may not be known that certain flavours are very closely linked with texture, and the condition in which the texture is found sometimes guides the grader to decide the keeping properties of the butter, or in other words, he finds in the texture the key to serious defects in flavour.

After a few boxes of butter have been graded in this way, the mouth should be washed out, or an apple eaten to freshen the palate, and boxes of sawdust should always be in readiness for sanitary purposes. Holding a tainted sample of butter in the



BUTTER GRADING—TAKING TEMPERATURES PREVIOUS TO GRADING.

BUTTER GRADING—GRADERS EXAMINING THE TEXTURE.

TAKING SAMPLES OF BUTTER FOR CHEMICAL AND BACTERIOLOGICAL ANALYSES.

CHECKING THE WEIGHTS.

mouth longer than is necessary, because no receptacle is near in which to spit, is injurious to the palate and it may be the cause of an error in judging the quality of a choice box of butter which may follow the testing of a tainted one. The palate should be tested by the grader as he proceeds with his work, and more especially if he has an impression that it has lost its keenness. He should return to the first two boxes he has graded and go through them with the same care as before, and if he finds his decision in any way differs from what he has given in his entry-book he should not place any further reliance on his judgment for that day.

Classification of Flavours.

Flavours may be classed in the following order, with a few examples in each case :—

Plant	Cress, Turnip, Mustard, Ensilage, Lucerne, Rape, Cabbage	These flavours, when not too strong in butter, have been proved by the writer to disappear from the butter after a week's storage at low temperatures.
Chemical	Bitter, Salty, Soda	Caused by added preservatives, such as borax, saltpetre, and ordinary salt.
Bacterial	Fishy. Old and stale. Musty. Tallowy. Cheesy. Rancid.	

In the grading of butter the grader should state to which of these classes the butter belonged; and for the information of an Agricultural Department and the produce trade some distinguishing mark should be put on the certificates to denote the class of flavour.

Descriptive Terms of Butter and Cheese.

There is need for a nomenclature to explain the terms descriptive of butter and cheese. Serious mistakes occur through the absence of this information, and until remedied the education of the butter maker will remain imperfect.

The writer has endeavoured to bring the subject under the notice of authorities in dairying in different countries.

Illustrations showing the dire necessity for action being taken in the direction mentioned, have been numerous, and during the past season an instance of more than passing comment came under the writer's personal notice while inspecting butter in Britain. This occurred at a large produce warehouse, where a parcel of produce was described as woody by the firm's leading salesman. On an explanation being asked as to the cause of the taint, it was stated by the merchant that the flavour was the result of cows eating tainted food, and not in any way caused by inferior butter boxes, as alleged in the Australian Press.

How a Uniform Nomenclature could be Prepared.

In arriving at some uniformity in the terms used, representative judges of butter could meet, say, in London, the party to comprise teachers of dairying, show judges, scientists, Government produce inspectors, and representatives from the proprietory and co-operative factories of Australia, and others whose opinions would be considered of value. Boxes of butter from every country exporting could be obtained for examination, all grades being shown, under different conditions of temperature, age, &c., and in which every flavour common to butter would be found, and every defect in texture, colour, and finish illustrated. Individual examiners would go through the butter, criticise the flavour, texture, and condition, and at the close of the inspection a comparison would be made of the opinions expressed. In this way a decision would be arrived at in respect to the terms, and were such meetings held biennially a complete list would be obtained for use in all countries. Such an innovation would doubtless prove of the highest value to factories in respect to authoritative reports on defects found in the produce in London, and also to Agricultural Departments, now that grading is being enforced by the Australian Commonwealth. Apart from this, a uniform scale would have other very important advantages.

Some of the Terms used in the Butter Grade-Sheets of the Queensland Department of Agriculture.

For Superfine Butter.

Aroma.	Flavour.	Texture and Condition.
Very choice.	Very choice.	Excellent.

In no condition should the superfine stamp be used unless the flavour and aroma of the butter are faultless.

First-Class Butter.

Aroma.	Flavour.	Texture and Condition.
Choice.	Choice.	Very good.

When a trace of fishiness, staleness, or rancidity is found, whether in the aroma or taste, the butter should not be stamped first class. Whatever weakness the grader finds in the butter that has caused him to reduce the points to a low first (90-91), such should be clearly stated in the certificates.

Second and Third Class Butter.

In produce of these grades, the defects in aroma, flavour, texture, and condition are fully stated in the grade-sheets. The same will apply to pastry butter.

Butters which Deteriorate quickly at Temperatures over 15° Fahr.

The following terms when used in the early stages of the defects stated, may be taken to determine that the butter may quickly deteriorate after inspection, and consequently turn out a lower grade if the proper precau-

tions are not exercised to thoroughly control the storage temperatures of the butter :—

Aroma and Flavour.	Extent of Either.		
Stale -	Faint,	distinct,	pronounced strong, or very strong
Rancid	,,	,,	,,
Cheesy	,,	,,	,,
Tallowy	,,	,,	,,
Oily -	,,	,,	,,
Fishy -	,,	,,	,,

True Test of Butter.

Experiments illustrate that a thoroughly sound butter will not change in flavour when stored at different temperatures below freezing points—that is to say, that temperatures of 5° Fahr., 12° Fahr., 18° Fahr., and even 30° Fahr., produce practically the same result. Were this system applied to show butters, it would be a searching test of the keeping properties of the exhibits. Where this cannot be done, the butter should be kept at a temperature of not higher than 32° Fahr., and not lower than 25° Fahr., when the choicest butter will prove its worth against grades of poorer quality.

We shall now deal with the subject of flavours, and explain to what is attributed some of the changes which take place in butter after it has been inspected, chief among which is the costly taint, staleness.

Definitions of some Flavours commonly met with.

Stale.—This flavour is commonly met with in butter made during hot and muggy weather, and may be divided into two classes—viz., staleness arising directly

from the quality of the cream, in which case the freshly churned butter will have evidence of it; and staleness following on the storage of butter for lengthened periods at varying degrees of temperature.

RANCID.—A rancid flavour may be taken to be the final stage of staleness, when butyric acid is produced in the butter. Produce of this quality is classed as third grade or pastry.

FLAT OR INSIPID.—In butter of this description, the much-desired flavour is wanting, its place being taken by something approaching the flavour of margarine, and which is described as being dead. In insipid butter there is nothing foreign or objectionable, nothing unclean, and, if the insipid flavour is the result of churning sweet cream, it may give rise to rancidity in the butter. Flavourless butter may also be brought about by overwashing the butter in the churn or on the worker.

LARDY AND TALLOWY.—When cream has been kept too long, and particularly if it contains a high proportion of fat, say over 40 per cent., the dangers are in hot weather that the oily consistency of the cream will tend to give to the butter a tallowy flavour. Chilling and thawing butter of this character will increase the possibility of these flavours developing, but it is a certainty that the injury to butter through the evil influence of thin or watery cream during the hot summer months far outweighs the losses arising from the churning of rich cream.

TEXTURE.—Heated—which favours tallowy flavours. Weak-bodied—without body or solidity. Underworked—not worked enough. Tough—tears in butter (seen

in frozen butter when thawed). Short—not worked. Gritty—as in clotted cream butter. Wet, dry, soft, spongy, creamy, salvy—weak butter overworked. Loose body—usually there is an excess of moisture in this quality of butter.

COLOUR.—Pale, deep, mottled. Muddy, as in blended butter which shows no bloom. Streaky, cloudy, milky. Colour shaded.

FINISH AND PACKING.—Uneven surface, bad finish, loose packing.

FLAVOUR AND GRADING.

At this stage the writer will deal as briefly as possible with the flavour of butter.

AROMA AND NUTTY FLAVOUR.—In examining butter, the judge first brings his sense of smell into use, and if the aroma thoroughly pleases him he may, without tasting the butter, class it a superior grade. Would this be the correct thing to do? In answering the question, we should certainly say, No. At this stage let it be considered what aroma really is. Aroma is the volatile gases which are detected when a sample of butter has been drawn with the iron and immediately placed under the nostrils. If the odour is attractive, what does it indicate? It shows that the butter possesses one good feature, but it does not give any reliable evidence that the flavour is choice and the butter has good keeping properties. Aroma is the deceptive element in butter, and all judges should recognise this when examining factory produce.

To properly determine the good flavour and its fixity

in export butter, the butter should be examined at least three days after manufacture, when it has had time to develop a flavour which is likely to be retained in the butter under favourable conditions. The writer repeatedly examined butter which had a fine aroma, but on tasting the product, evidence was given of the presence of a bad flavour, which in some cases quickly develops under ordinary conditions. On the other hand, bad flavours which are volatile, are very pronounced by smell, although not readily detected by taste. This further shows the absurdity of grading on smell only. Biting the butter from the iron used in taking the sample should always be done, except in cases of badly tainted butters, when their grade can be determined by the strong volatile odours.

NUTTY FLAVOURS.—A nutty flavour is a term we are accustomed to use when speaking of a good quality of butter, but the writer has only once found what he could describe as a nutty flavour, and which he will refer to later on. It might be asked what is meant by a nutty flavour? The users of the term will tell you it resembles nuts, and that is all they can say about it. Perhaps it would be wise to throw nuttiness out as an obsolete and misleading term, or it might be better to submit the question to a body of experts for their decision.

FATTY ACIDS.—That the fatty acids contained in butter produce flavour and aroma is supported when we consider that in margarine there is a small proportion of volatile acids and a high percentage of fixed acids. It is well known that margarine is a dead substance, some-

thing without flavour, whereas butter is very attractive in flavour, and the finest quality is pronounced in aroma.

WHAT CAUSES A GOOD FLAVOUR?—This is a very wide question, and it is universally believed that bacteria are responsible for the aroma and good flavour of butter and cheese. Up to the present there is no evidence to prove whether one variety of organisms or many varieties are credited with these valuable changes, although we have reason to accept that the *Bacillus acidi lactici*, or lactic acid germ, is the chief agent. But when the practical side of dairying is considered, there is something to say in favour of the food consumed by the cow being responsible for both aroma and flavour in produce. This might result from an indirect action of bacterial life. However, it will not be an error to recognise the value of food as playing some part in producing those valuable characteristics in milk, cream, butter, and cheese. It is recognised that certain districts are famed for their good quality of butter, while other districts produce an insipid and otherwise poorer article. Why should this be so when conditions of manufacture are practically the same? In Scotland, influence of district was apparent to the writer many years ago, and in South Australia and Queensland there was similar evidence. Further, the texture and keeping properties of butter bear marked relationship to district, and some of the finest butter the writer has ever tasted was made from cream produced in undulating country, where the herbage that grew on the slopes and hillsides of the dairy farms was prized for its sweetness and butter-flavouring qualities. The water on these

farms was noted for its purity, and the atmosphere was dry and bracing. Cows were especially healthy under these conditions, and, needless to say, there was a keen demand for the milk for dietetic purposes as well as for the butter. In examining the milk and cream from those farms, a fine flavour was invariably pronounced, and the keeping properties of the butter stood out as a marked feature in favour of the district for dairying. On the other hand, butter and cheese manufactured in wet tracts of the same country and on sewage land only 15 miles distant were wanting in the same attractive characteristics as those described.

FOOD AND FLAVOUR.—That food influences flavour in dairy produce was further illustrated in an extensive experiment carried out by the writer at the instance of the Sunlight Soap Company to test the feeding properties of their copra-cake for milking stock. In the butter made from the milk of cows fed on the cake, the delicate flavour of the nut could be quickly detected, and when the supply of cake was increased the flavour correspondingly grew stronger. Again, if aroma and flavour exclusively follow the action of bacteria, why is it that pasteurised butter is not superior in these respects to butter made from cream ripened under ordinary conditions? In making this remark the writer does not grudge the system of pasteurisation the honour which it deserves in giving a good flavour to butter, and which is retained for a longer period than the average quality of non-pasteurised butter. In the Danish product we have an illustration of this, but the Danish butter is not superior in aroma and flavour to the finest non-pasteur-

ised New Zealand and Australian produce. There are many other instances which could be given in support of this argument. Meanwhile, let the farmer pay greater attention to the food of the cow, water supply, and cleanliness, as these are active agents in producing choice flavours in our butter and cheese.

FIXITY OF FLAVOUR.—When pure cream is carefully ripened, hurtful organisms which are likely to give rise to bad flavours in the butter are prevented from growing in the cream owing to the predominance of the good bacteria which produce the choice flavour. In the butter made from this quality of cream the flavour is fixed. On the other hand, if a quantity of second-class or tainted cream is mixed with many times its weight of the choicest cream, the flavour of the butter will most likely be attractive at the time of churning or a day or two after the butter is made ; but in this butter the fine flavour is temporary, or, in other words, it is not fixed. This flavour will soon be displaced by a bad one, which arises from the greater vitality of the taint-producing organisms originally in the cream, and their rapid development in the butter under favourable conditions. In testing butter of this character the examiner exercises all precautions against error, and it is suggested that in dealing with butter of suspicious quality, one box should be withdrawn from each churning and kept at a temperature of from 55° to 60° for three days, when the defects of the butter are likely to be more correctly determined. A more thorough test of the keeping properties of this class of butter would be to chill the product to a temperature of 40° Fahr. for the same

period, and then thaw to 60° Fahr. or thereabouts, when the true character of the churning could then be ascertained.

The Preservation of Butter at different Temperatures.

With a view to ascertain the changes which different qualities of butter undergo at varying degrees of cold, the writer had an extensive test made. Forty-four boxes of butter were stored in four different chambers for a period of eight weeks, the temperature of the chambers being kept at 5, 12, 18, 25 to 32° Fahr. respectively. A careful examination was made of the butter before storage, also the weights were taken to determine the extent of shrinkage.

The following is the result of the test :—

Lot.	Before Refrigeration.	After Refrigeration.	Shrinkage.
	Lbs. Oz.	Lbs. Oz.	Oz.
1. Salt Butter - -	55 4	55 1	3
	56 6	55 5	1
	56 1	55 14	12
	56 6	55 8	14
Total loss, 32 oz., or 7½ oz. per box.			
2. Salt Butter - -	56 14	55 6	24
	56 10	55 14	12
	56 14	55 6	24
	55 12	54 13	15
Total loss, 75 oz., or 1 lb. 2¾ oz. per box.			

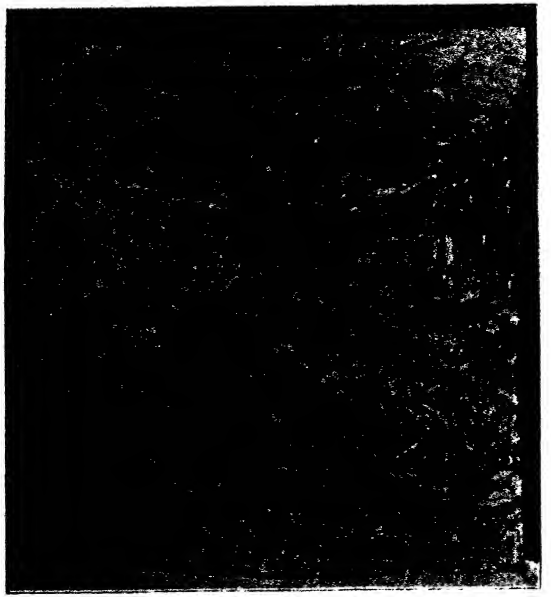
Lot.	Before Refrigeration.	After Refrigeration.	Shringage.
	Lbs. Oz.	Lbs. Oz.	Oz.
3. Salt Butter	56 7	56 4	3
	56 3	56 0	3
	56 4	55 7	13
	56 6	56 1	5
Total loss, 24 oz., or 6 oz. per box.			
4. Salt Butter	57 0	56 2	14
	57 0	55 13	19
	57 0	56 0	16
	57 0	55 14	18
Total loss, 67 oz., or 1 lb. (approximate) per box.			
5. Unsalted Butter	56 12	56 6	6
	56 12	56 2	10
	56 12	56 10	2
	57 0	56 13	3
Total loss, 21 oz., or $5\frac{1}{2}$ oz. per box.			
6. Unsalted Butter	56 0	55 12	4
	57 0	56 10	6
	56 14	56 10	4
	55 14	55 12	2
Total loss, 16 oz., or 4 oz. per box.			
7. Unsalted Butter	56 6	56 4	2
	56 8	56 4	4
	56 10	56 8	2
	56 8	56 6	2
Total loss, 10 oz., or $2\frac{1}{2}$ oz. per box.			
8. Salted Butter	56 10	56 8	2
	55 8	55 6	2
	56 6	56 3	3
	56 10	56 8	2
Total loss, 9 oz., or $2\frac{1}{8}$ oz. per box.			

Lot.	Before Refrigeration.	After Refrigeration.	Shrinkage.
	Lbs. Oz.	Lbs. Oz.	Oz.
9. Unsalted Butter	56 8	56 6	2
	56 8	56 5	3
	56 4	56 2	2
	56 12	56 10	2
Total loss, 9 oz., or $2\frac{1}{8}$ oz. per box.			
10. Unsalted Butter	56 9	56 6	3
	56 1	56 5	5
	56 9	56 6	3
	56 8	56 1	7
Total loss, 18 oz., or $4\frac{1}{2}$ oz. per box.			
11. Salted Butter	56 9	56 2	7
	56 8	56 4	4
	56 9	56 6	3
	56 8	56 4	4
Total loss, 18 oz., or $4\frac{1}{2}$ oz. per box.			

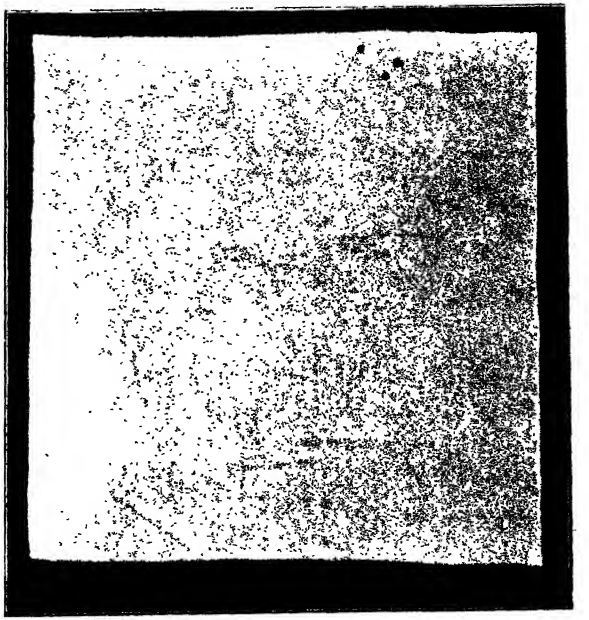
Lots 10 and 11 came from the same manufacturer, who sent the following report of the butter:—

	Temperature of Cream.	Time of Churning.	Temperature of Water.	Size of Grains.	Time Draining.	First Working	Interval between First and Second Working; Temp., 52° F.	Second Working.
		Mins.	Fahr.		Mins.	Mins.	Hours.	Mins.
Unsalted	57°	30	46°	Peas	30	1	6	2
Salted	57°	30	45°	Peas	30	$1\frac{1}{4}$	6	$2\frac{3}{4}$

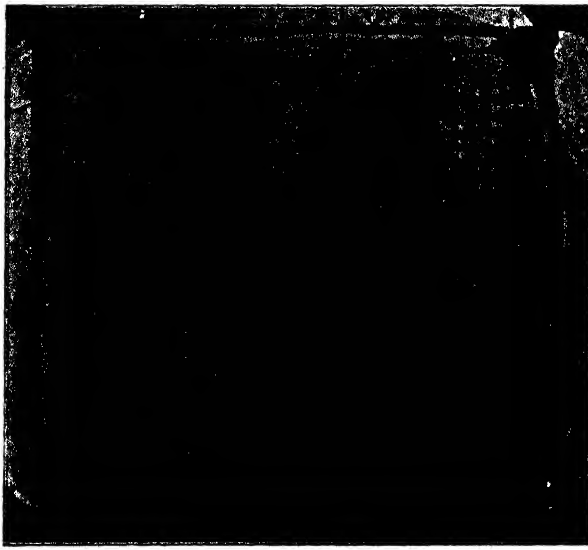
It will be observed that the uniformity in the treatment of this butter (Nos. 10 and 11) had produced a satisfactory result in the shrinkage of each box.



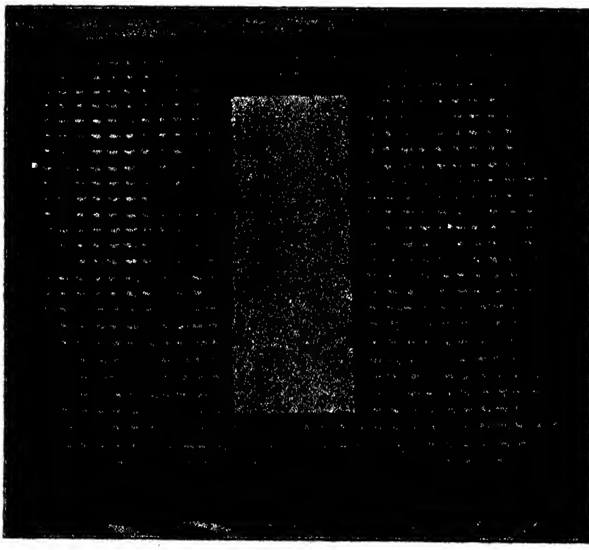
STREAKY BUTTER.



BUTTER FREE FROM STREAKINESS.



BADLY-FINISHED BUTTER.



WELL-FINISHED BOX OF BUTTER. CLEAR SPACE IS FOR THE FACTORY BRAND.

BADLY PACKED AND SHORT WEIGHT BUTTER.

Throughout the test it is noteworthy that at the different storage temperatures the butters show in some cases marked differences in weight, which may be attributed to a number of causes. The first four lots suffered the greatest loss through shrinkage, and these were salt butters, in which the moisture was loose or insufficiently incorporated. In cases of this kind the escape of moisture would be increased. In salted butters which have been worked twice and contained not more than 12 per cent. of water, it is certain that the shrinkage would be small, but the least escape of moisture is accredited to unsalted butter which had been compactly worked, without reducing the proportion of water below the average of unsalted butter. In unsalted butter the distribution of moisture is exceedingly even, and is firmly retained amongst the particles of butter-fat; but an unsalted butter may contain as much as 17 per cent. of water without showing any traces of excessive moisture on the trier or in the appearance of the product, as investigations by the writer have clearly shown, and which will be fully detailed in "Dairying for All Countries."

Changes in Flavour.

In the flavour of the butter great changes took place, the extent of which will be more easily followed from the subjoined table :—

Lot.	Before Refrigeration. Flavour, 50 points.		After Refrigeration. Flavour, 50 points.		
	Points Awarded.	Defects.	Temperature.	Points Awarded.	Defects.
			Fahr.		
1. Salted	36	Stale and inclined to fishiness	25-32°	32	Very stale and fishy.
			18°	32	,, ,,
			12°	33	Stale and fishy.
			5°	35	Slightly stale and fishy.
2. Salted	29	Very stale and inclined to fishiness	25-32°	25	Very stale and very fishy.
			18°	25	,, ,,
			12°	26	,, ,,
			5°	29	Stale and fishy.
3. Salted	44	Choice	25-32°	38	Fishy and slightly stale.
			18°	38	Pronounced fishiness.
			12°	39	Fishy.
			5°	41	Trace of fishiness.
4. Salted	40	Slightly sour	25-32°	34	Stale and fishy.
			18°	34	,, ,,
			12°	36	Stale and faintly fishy.
			5°	39	Slightly aged.
5. Unsalted	42	Good	25-32°	38	Aged.
			18°	36	Stale.
			12°	40	Weak.
			5°	42	Good.

At temperatures of 12° Fahr. and 5° Fahr. the butter was classed as a low second and a medium second.

At a temperature of 5° the butter showed no difference in quality from the first examination.

This butter improved from a second to a first at a temperature of 5°.

There was also a distinct improvement in flavour at the lower temperatures.

At a temperature of 12° the butter benefited to an extent of 4 points, and at 5° it gained a further 2 points, making it similar to the award previous to refrigeration.

Lot.	Before Refrigeration. Flavour, 50 points.		After Refrigeration. Flavour, 50 points.		
	Points Awarded.	Defects.	Temperature.	Points Awarded.	Defects.
6. Unsalted	44	Choice	Fahr. 25-32°	32	Very stale.
			18°	34	Very fishy.
			12°	38	Fishy.
			5°	42	Developing fishiness.

The lowest temperature again proved the most valuable as a preservative of flavour.

7. Unsalted	42	Weak	25-32°	39	Acidy.
			18°	40	,,
			12°	40	,,
			5°	40	,,

There was no change in flavour at the three lowest temperatures.

8. Salted	43	Choice	25-32°	32	Stale and very fishy.
			18°	38	Slightly stale and slightly fishy.
			12°	39	,, ,,
			5°	40	Trace of fishiness.
9. Unsalted	*35	Stale	25-52°	27	Very stale.
			18°	29	Stale and fishy.
			12°	30	,, ,,
			3°	35	Slightly stale and trace of fishiness.
10. Unsalted	43	Choice	25-32°	38	Stale.
			18°	40	Slightly stale.
			12°	38	Fishy.
			5°	34	Very fishy.

At the lowest temperature fishiness developed very strongly.

11. Salted	43	Choice	28-32°	38	Very fishy.
			18°	40	Weak.
			12°	42	Good.
			5°	40	Trace of fishiness.

Fishiness was again present at a temperature of 5° Fahr.

Testing a Fishy Box of Butter.

A box of butter which was equally divided into two 28-lb. parts was stored at from 25° to 30° Fahr., and 5° Fahr. respectively. At the conclusion of the experiment, the part which was kept at the higher temperature—25° to 32° Fahr.—was very fishy in flavour, while that stored at 5° Fahr. was considerably weaker, the distinction being that the former was graded a low third and the latter a low second.

The deductions to be taken from the experiments are as follows :—

Fishiness.

A fishy flavour will develop in both salted and unsalted butter, although in the salted product the flavour is more generally met with. There is, however, evidence to show that a fishy flavour may develop as rapidly in unsalted as in salted butter, or it may even be stronger in the unsalted butter at certain temperatures. No difference in the strength of the flavour could be detected throughout any box of fishy butter, showing that the growth of the flavour was not more pronounced in one part than in another. Fishiness was more general in butter which was stored at temperatures of 18° Fahr. and 25° to 32° Fahr., but the flavour was found in boxes of butter at a temperature of 5° Fahr., and it was pronounced in three boxes of salted and unsalted butter at that temperature. From the test one might infer that it would require a temperature lower than zero to prevent the development of this ruinous taint in Australian butter.

Stale Flavours.

The striking features of the experiment were the pronounced stale and rancid flavours in butter which were kept at a temperature from 25° to 32° Fahr., and the consistent weakening of the flavour at temperatures of 12° and 18° with its entire absence at a temperature of 5° Fahr., in the case of butters which were not affected with these flavours at the commencement of refrigeration.

Boxes of butter which were either slightly "off" or distinctly "off" in flavour when refrigeration began, did not develop a stronger flavour at 5° Fahr., or in other words, the affected butter practically came out of the chamber (5° Fahr.) in the same condition as it went in. Out of the 44 boxes tested before refrigeration, stale flavours were found in 16 boxes. After refrigeration at temperatures from 25° to 32° Fahr., 42 were found affected, the flavour having greatly increased; and 5 boxes which were previously free from stale and rancid flavours became tainted at the above temperatures. At a temperature of 18° Fahr., 5 of the tainted boxes were found to show less pronounced stale and rancid flavours. At a temperature of 12° Fahr., 5 boxes showed a stale flavour. At a temperature of 5° Fahr., 4 of the 9 boxes which showed a stale flavour at a temperature of 25° to 32° Fahr., developed the taint, and only 4 out of all the boxes which were stored at 5° Fahr., showed varying degrees of staleness which were noticeable in the butter in three instances before the butter was refrigerated.

Chilling Temperatures.

The writer has no hesitation in saying that if a temperature of 5° Fahr. was maintained in the chambers of oversea vessels, a very great increase in the profits from butter exports would follow. It may safely be asserted that in a shipment of 20,000 boxes of butter from Australia the produce would be worth at least 4s. more per box at a storage temperature of 5° Fahr., and this would amount to £4,000, which would give a handsome balance to the exporter and the State after paying the extra cost of steamer refrigeration. (See Flavours.)

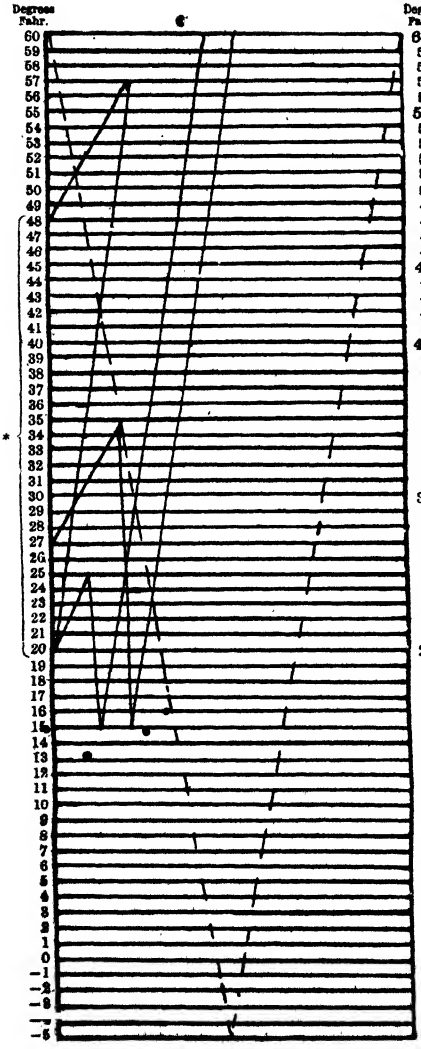
Lower Temperatures Required.

The experiments we have concluded prove that a lower storage temperature than was previously recommended is required to maintain the good flavour in export butter. In making this recommendation the writer would refer readers to the following diagram :—

The dotted lines show what is desired in the refrigeration of butter,—no fluctuations of temperature; and in thawing the produce the same is attendant with beneficial results.

Encouraging Bad Flavours.—On the left hand side of the diagram (shown by *) an example is given of what sometimes occurs in the handling of produce, and which is most damaging to the market value of export butter. In this instance, butter was reduced to a temperature of 48° Fahr.; after a time it was allowed to rise to 57°, but this was not maintained, the temperature being quickly lowered to 20°. A rise of 5° followed, which is not unusual in the carriage of butter from cool stores to vessels. Finally the produce was put on board steamer and carried at the usual temperature of 15° Fahr.

Again, butter may be chilled to 27°, neglect may cause it to go up to 35°, after which it is put into the cool chambers of oversea vessels. Refrigeration will be more fully dealt with in "Dairying for all Countries."



60. Grading temperature of boxes of butter of doubtful quality These should previously be chilled for a few days at a temperature of 30° Fahr.

45-55.—Grading temperature of export butter. Temperature of grading-room, 50° Fahr.

40-60.—Fermentation is rapid between these temperatures, the rapidity following the quality of the cream from which the butter was made.

30-40.—Fermentation is very destructive in doubtful butter which has been kept in storage at degrees of cold varying from 30° to 40° Fahr. Stale, rancid, and aged flavours and fishiness develop steadily at these temperatures.

20-30.—Butter from cream of mixed quality when refrigerated for a period corresponding to the voyage from overseas ports to England will show marked signs of deterioration, stale and fishy flavours predominating.

10-20.—There is a marked decrease in stale flavours between these temperatures, but fishiness in both salted and unsalted butters may continue to develop.

5-10.—Stale flavours are held in check, and fishiness is much reduced at these degrees of cold.

0.—It is believed that stale flavours are unable to grow at zero, and fishiness may only be found in occasional cases.

It is the opinion of the writer that a fishy flavour will not develop at 5° Fahr

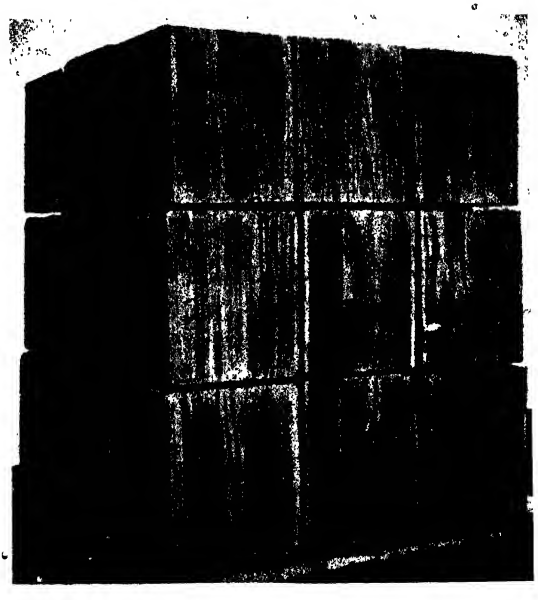
Fluctuations in temperature favour oily, tallowy, and cheesy flavours. Also, fishy and stale flavours are influenced

Storage Defects.

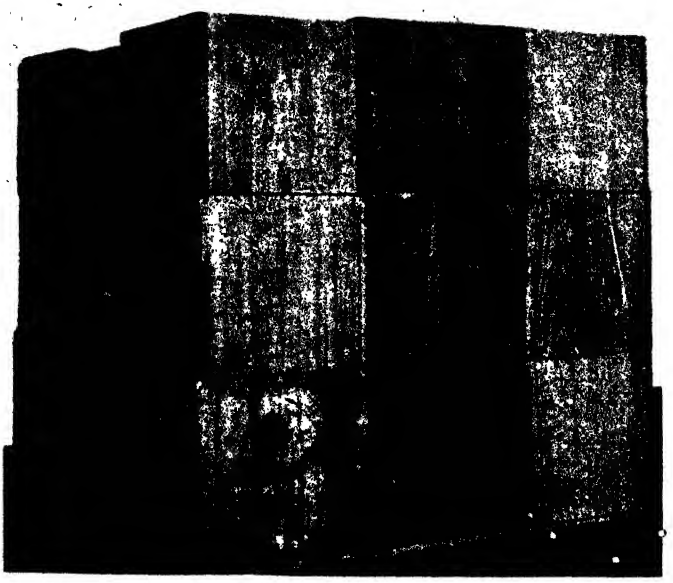
Injury to butter is caused by defects in storing the boxes. If the cases are packed close together in the chamber without an air space around each one, uneven chilling will be the result, as it will take longer for the boxes furthest away from the air of the chamber to benefit by the cold. A large consignment of butter kept in this manner for weeks at a temperature not exceeding 32° Fahr. would show signs of a difference in quality. This matter requires strict attention by factories, depôt authorities, and exporters, and the illustrations given should be a sufficient warning of the dangers following the practice of careless storage.

Grading and Marking Boxes.

These experiments have shown that the marking of butter boxes with grade distinctions gives the manufacturer a distinct advantage in the disposal of his produce in British and foreign markets, and it makes clear the cause of the opposition some importers have shown against the system of marking boxes. At unsuitable temperatures in the storage of butters, the danger is for some brands to lose in quality, thereby injuring the factory; but the producer has been asked to believe that stale produce improves in flavour in cool storage, and second and third grades of butter turn out in London a choice quality. The writer has



REFRIGERATING BUTTER.
SHOWING HOW BUTTER SHOULD BE STACKED TO PROVIDE A FREE CIRCULATION OF COLD AIR.



System of Stacking which prevents successful Chilling.

had overwhelming evidence of the foolishness of this assertion, and the regrading of butter of doubtful quality at the port of shipment shows what an advantage the exporter has through the marking of butter boxes.

A Fatal Error.

It has been shown that large quantities of butter bearing the choice brands of factories are of a doubtful character, that is to say, the butter scores at the factory 90 or 91 points; but as produce of this standard invariably shows the effects of stale or aged cream, it would be positively dangerous to grade it first class. Butter of such a quality quickly deteriorates, as we have already shown, and which proves that it has no right to a first grade mark, although it might be first class, were it to go into consumption immediately after grading. But it is to butter of this quality which graders may have shown some leniency, and it is this class of butter that has been arriving in England a second grade. No one need be surprised that the importer has asked for the discontinuance of the official mark. But the first-class official mark has improved the price of the produce by at least 1s. per box, and in this dairy farmers have an illustration of what the anti-grader is doing for them by demanding that the official mark should be kept off the boxes. The attempt of factories to get a large proportion of their butters graded as first-class with a bare pass—

90 or 91 points—is very unprofitable and injurious to the industry; and this is further borne out when a smaller proportion of the butter scoring 93 and 94 points realises per box a correspondingly higher price. When all things are considered, the factory would be the gainer in both money and reputation.

The case represents itself thus: If a class of butter which is a superior second or a low first realises a price equivalent to a good first quality butter or a superfine, what would be done with low grade butter if the official grade marks were kept off the boxes? It would follow that the grocers of Great Britain would be buying third grade and pastry butters at first and second-class prices at periods when the British market is dangerously erratic, as experience has shown. But the anti-graders will say: Why should we not get the benefit of a peculiar market and dispose of our unstamped pastry butters at famine prices? The answer is feasible. By stamping the inferior grades the factory and the State are protected against the pernicious sales for low grade butters which follow phenomenally high market rates, and these sales have been shown to be very dangerous and hurtful to the dairy farmer of export countries.

GRADING POINTS.—In different countries there is a different scale of points used. Uniformity is much desired in all countries. In the opinion of the writer the general scale of points for flavour is too low, causing an insufficient distinction between the different grades. For example one reads of a prominent judge classing a

94 butter as second grade with the following commen
"It cuts well, being closely put together, but that is a
you can say in its favour."

As flavour is practically the price of butter, 60 poin
out of 100 should be allotted this element, and not 4
as is customary. The writer would suggest the follo
ing scale:—

Flavour.	Texture.	Colour and Finish.	Total.
60	25	15	100

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